ENGINEERING NEWS

THE Poughkeepsie bridge proper having been finished some time ago, the question of its connections eastward has naturally excited curiosity. This uncertainty is now solved, says the *Daily Eagle* of that town. The original projectors of the bridge expected to secure the New York & Massachusetts Railroad, which is the most direct route east, but the control of this road passed into the hands of HENRY D. CONE, of Stockbridge, Mass., who would only connect on a traffic basis, and declined to sell on any reasonable terms. The syndicate controlling the bridge then secured a controlling interest in the Hartford & Connecticut Western R. R. and threatened to parallel the New York & Massachusetts from Poughkeepsie northeast to the Hartford & Connecticut Wes ern road. All negotiations with Mr. CONE having failed, work is now to be commenced in earnest on this parallel line. The new corporation, which filed its papers one year ago, is known as the Poughkeepsie & Conn. R. R., and its surveys have all been made. They have already secured possession of the one strategic point on the line near the junction between the New York & Massachusetts and the Newburgh Dutchess & Connecticut roads, where only one line is possible without undue expense; it is a point that was wanted by the N. Y. & Mass. R. R. The new line will connect with the Hartford & Conn. Western R. R. at Silvernail's Bridge; a branch to Springfield will also soon be put in to open New England to the bridge traffic. Mr. CHAS. MCFADDEN, the well known Philadelphia contractor, is to build the new line.

On the west side of the bridge the Hudson Connecting R. R. Co., a corporation formed in the interest of the bridge syndicate, is building a railroad from Poughkeepsie through Ulster and Orange counties to Campbell Hall, at the junction of the Erie, New York, Ontario & Western, and Walkill Valley Railroads. About a thousand hands are at work on the grading, and it is intended to complete the line at the earliest possible time, as trains can then begin running over the bridge.

A BILL introduced in the House Oct. 15, by Mr. FARQUHAR, of New York, confers upon Messrs. RUFUS HATCH, HUGH R. GORDON, EGBERT L. VEILE, HENRY C. DAVIS, MOSES B. MACKLAY, CHAS. D. INGERSOLL and GEORGE C. LEE, their associates and successors, the right to erect, maintain and operate a bridge, with suitable approaches thereto, commencing at any point in the city of New York that shall be determined upon, and running thence over and across the Hudson River into the State of New Jersey. Said bridge to be used for the passage of railroad trains, and for any other purposes. It is provided that the proposed bridge shall be constructed with a single span over the entire river between the pier lines in each State, and at an elevation above high water mark of at least 142 ft., and no pier or piers or other obstructions to navigation of permanent character shall be placed or built in the river between the said pier lines under the act. This reads very much like Mr. LINDENTHAL'S suspension bridge project lately set forth in this journal, and in the light of its necessity and the opportunity presented for some very bold engineering we wish it good speed.

CORPORATION COUNSEL BEEKMAN has rendered an opinion to the Aqueduct Commission as to what is due the Croton Aqueduct contractors, taking precisely the view of the question which has been taken in these columns. Mr. BEEKMAN concludes that $738,389.75 has been allowed improperly for extra excavation outside the line known as "the line AAA." which is the required clear section. This is the aggregate of $585,498.85 paid on the recommendation of Chief Engineer CHURCH for extra excavation prior to May 23, 1887, and $152,890.90 since that date. Mr. BEEKMAN answers the five questions propounded in the report of the Committee of Finance and Audit, by saying that the outer line of excavation for which the contractors can claim pay was to be fixed as the work advanced, and should not be determined and applied to a section or sections completed. The contractors, he says, must build masonry beyond the line adopted, as far as the Chief Engineer directs; but the mere fact that the masonry was built beyond such line did not give them a right to be paid for extra excavation. The allowances made for such extra work before May 23, 1887, were therefore illegal, and must be recovered by the city. These sums may be deducted by the Controller from the money which the city has withheld from the contractors since April last, or it may be deducted in detail from the monthly estimates hereafter presented. If such deduction would embarrass the contractors and delay the work, the repayment may be left for the final settlement.

CONTRACTOR O'BRIEN is said to have remarked with a laugh, on hearing this opinion, "That's all nonsense. It will be all right after the election," and Chief Engineer CHURCH to have said that it "would be found that Mr. BEEKMAN is in error as to his conclusions regarding the Chief Engineer's powers under the law and the Aqueduct contracts. This is not a question of law, but a question of engineering. Mr. BEEKMAN in this opinion runs counter to the written opinions on the subject of his two immediate predecessors in the Corporation Counsel's office, Judge LACOMBE and Judge O'BRIEN Not only that, but he takes a view exactly contrary to that given by three of the ablest contract lawyers in the city of New York." We think both Mr O'BRIEN'S and Mr. CHURCH'S views will prove to be erroneous, as we have noted editorially.

THE New Croton Aqueduct Board have just awarded the N. Y. & New England R. R. Co. $75,817.64 for changes of line made necessary by the construction of the Sodom Dam reservoir. This is in place of the $110.000 awarded by the late Commission and objected to as excessive by Corporation Counsel LACOMBE.

THE Safety Car Heating and Lighting Company was lately incorporated with a capital of $500,000. The Trustees are MAX BRICKNER and ABRAM STETTHEIMER of Rochester, and ADOLPH BROSKOWITZ and SIGMOND STEINHARDT of New York.

THE WORST ACCIDENT OF THE WEEK is another bad one on the Lehigh Valley, illustrating the fact that misfortunes never come singly. It is again between a regular and "special" train, this time a grave train; 7 men were killed and 29 injured. It was a head collision between a regular freight and a work-train consisting of 8 cars with a construction gang and a caboose, many of the deaths and injuries having been in the latter car, by a rather unusual exception. The engine crew of the freight train escaped uninjured. The accident appears to have been primarily due to carelessness of the construction train hands, and secondarily to a combination of fog and a curve.

THE West Point tunnel on the West Shore Railroad caved in suddenly at 7.45 P. M. Tuesday evening, Oct. 16, wrecking a passenger train, but by a fortunate escape not very badly, nor with loss of life. The engine was not injured, but the next two cars, filled with baggage and express, were completly crushed and the tunnel filled with debris. The roof of the tunnel was 130 ft. below the surface of the Military Academy parade ground, and the cave-in extended to the top, a hole 20 ft. deep and 50 ft. in diameter being reported. Repairs will probably be made by excavation from above, and the cost is likely to be considerable. The immediate provoking cause of the fall appears plainly to have been the tremor from the train, from the time at which it fell. The lining has been giving evidence of weakness for some time and the work of strengthening it by inserting steel ribs was going on when the fall occurred.

SERIOUS FLOODS have occurred during the week in Maine and New Brunswick. Several washouts were caused on the New Brunswick Railway and the Northern & Western Railway; some of them were 200 to 500 ft. long. It is reported that the floods in the western and southern part of the province are the worst known for 20 years.——At Little Chute, near Appleton, Wis., the coffer-dams at the locks have been partly carried away by the river.

AN EXPLOSION of accumulated gas occurred in the new water-works tunnel at Cleveland, O., Oct. 5,

A BREAK in the Cornwall canal occurred 6 miles west of Cornwall, Ont., on Oct. 12; 200 ft. of the bank giving way. This will cause a serious inteference with traffic. It was stated that it would take 10 or 12 days to repair the damage: the work of repairing the break will be prosecuted day and night, the electric light being used.

A BRIDGE accident is reported as follows: On Oct. 6 a wagon bridge near Winona, Minn., was destroyed by fire.

THE boiler of a traction engine, near Highland, Ill., exploded Oct, 15, killing one man and injuring three others.

RUMOR has it that Philadelphia has adopted a sensible plan for burying its electrical wires. The companies will build a brick conduit 8 ft. high and 4 ft. wide, in the main streets and avenues. In these will be 50 3-in. pipes, each containing 100 wires. One connection will be made in each block, with a main from the conduit under the house line to the middle of the block, where a tall pole will distribute wires to the rear of the houses. Powerful pumps will keep the conduits full of dry air. Work is said to be fairly started.

M. DE LESSEPS is now reported to be "stumping" France, trying to get subscribers for the untaken balance of the last loan on condition that if the whole is not subscribed for, all the subscriptions fall to the ground. It is hard to make out exactly the precise nature of his proposal, but the general fact that he is in urgent need of more money and that i is hard to get it is apparent. In the meantime, on Nov. 19 next M. DE LESSEPS will be 84 years of age, and his anxieties and pressing cares must surely be telling on him, so that his active management can hardly be expected to continue much longer. His death would probably give the *coup de grace* to the Canal Co.

THE Canadian Pacific Railway Co. has signed a Pacific mail contract with the English Government, says a Montreal despatch. The service is to commence in 18 months and the company will receive $225,000 annually from the Imperial Government and $75,000 from the Dominion Government, for 10 years, for a monthly service to Yokohama, Hong Kong and Shanghai. If an 18 knots average can be made on the Atlantic end, the Canadian route to Hong Kong can easily compete with the Suez line. The necessity for fast ships is thus indicated, and the despatches hint that Australia with only 4,000,000 population pays $1,575,000 for purely ocean service, instead of the small amount appropriated by the Dominion as above given.

THE PENNSYLVANIA RAILROAD Co. last week awarded the contract for building 1,500 box cars, to be equipped with the Wagner car-door, the Westinghouse air-brake and the Janney coupler. The C., St. L. & P. company is in the market for 500 box cars, to be equipped in the same manner, and other roads are taking less decided steps in the same direction. The movement for freight air brakes and automatic couplers is now well under way, and in a very few years they are likely to become universal.

FAST train service between Chicago and Missouri river points is to be resumed, the Chicago & Northwestern having given the required 90 days notice of withdrawal from the agreement made some months ago to take off fast trains. The Chicago & Alton will put on a limited vestibule train in the spring which is expected to make the run from Chicago to Kansas City in 12 hours.

THE CASPIAN & BLACK SEA NAPHTHA CONDUIT CO. has been organized to build a pipe line to connect the Caspian and the Black sea. The work is to be completed in 3 years and 6 months from April last. The conduit from the small peninsula of Abcheron, on the Caspian, is to have a forked line on the Black sea, reaching Batoum and Poti. The capacity of the proposed line is to be 1,200,000 galls. (240,000 puds) of naphtha per day. The capital of the company is 14,000,000 rubles, and the property and plant are to become government property at the end of 60 years.

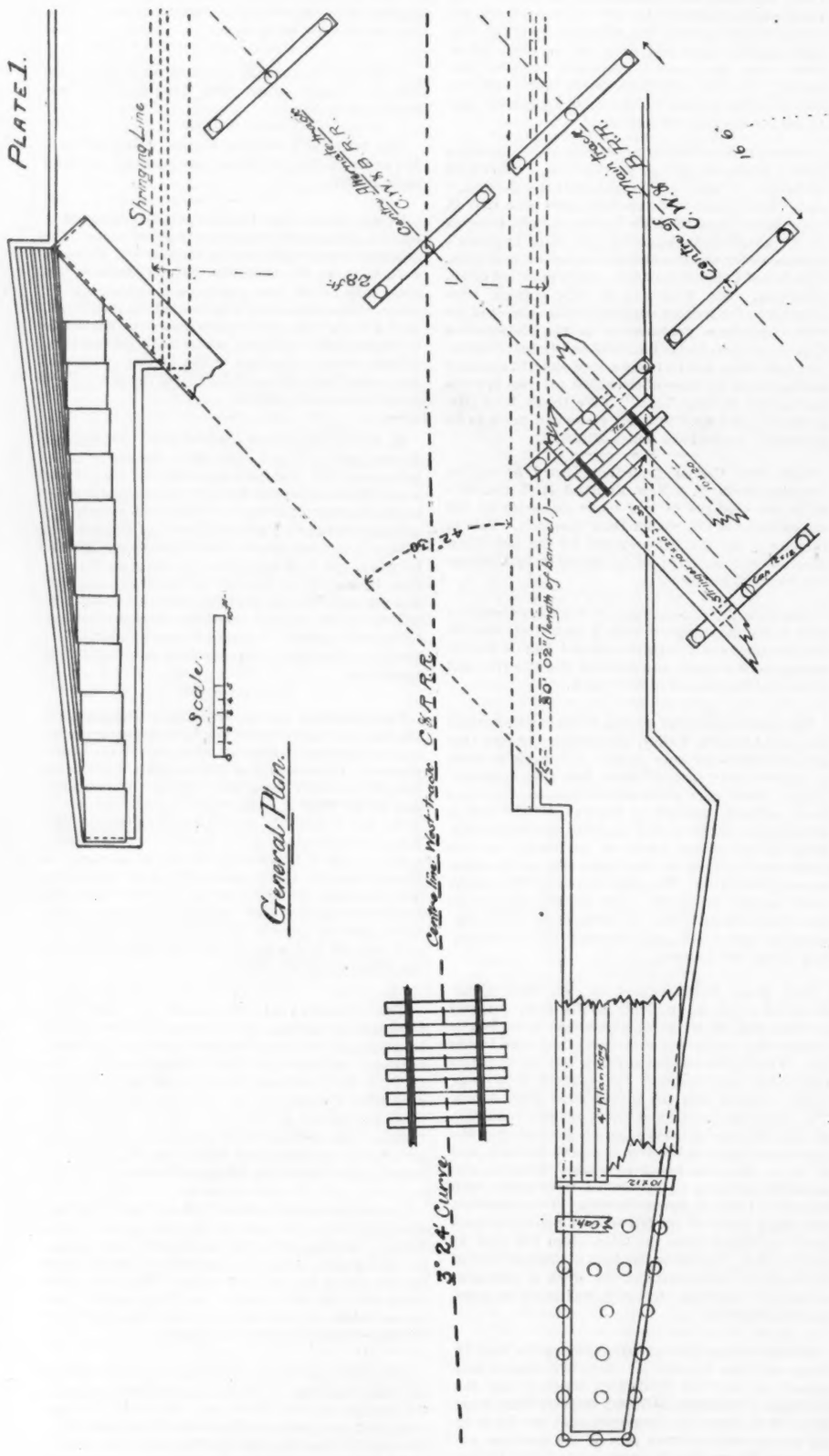


Plate I. Spiral Arch; General Plan and Location.

The Construction of a Skew or Spiral Arch.

BY M. P. PARET, DIV. ENG. C. & R. R. R. *

As a preface to this paper, it might be well to say that it has been made a sort of history of interesting points in the construction, trusting that it would be found more interesting than if the same space had been given to detail in the matter of developments, spirals, etc., no more of which has been introduced than is necessary for proper illustration and conception.

The Cincinnati & Richmond Railroad is being built by the management of the Pennsylvania lines west of Pittsburg, with a view of further developing and relieving existing lines. It connects with the Little Miami Railroad at Red Bank station, about seven miles from Cincinnati, and runs northwest through Reading and Hamilton, Ohio, to Richmond, Indiana. Only the portion between Red Bank and Hamilton is now under contract. About two miles from Red Bank it crosses the Cincinnati, Washington & Baltimore Railroad, under grade; at which point was built the spiral arch, the subject of this paper.

The C. & R. is in fill here (about eight ft.) and top of rail is about 27 ft. below that of the C. W. & B; this makes the C. W. & B. embankment about 35 ft. high. The alignment of the C., W. & B. is straight, with an ascending grade each way from the crossing of about 1 5-10 per cent. The grade on the C. & R. is 0.4 per cent. ascending, and the alignment a 3° 24′ curve to the left, a tangent to which makes an angle of 42° 30′ to the left with the C., W. & B. at the intersection. About 100 ft. to the right of the crossing is a 20 ft. full centered arch under the C., W. & B. through which runs a stream called Duck Creek. This is a very rapidly rising and turbulent stream in high water, changing its channel and overflowing the adjoining flats to a depth of 4 or 5 ft.; in such cases the 20 ft. arch would run nearly crown full.

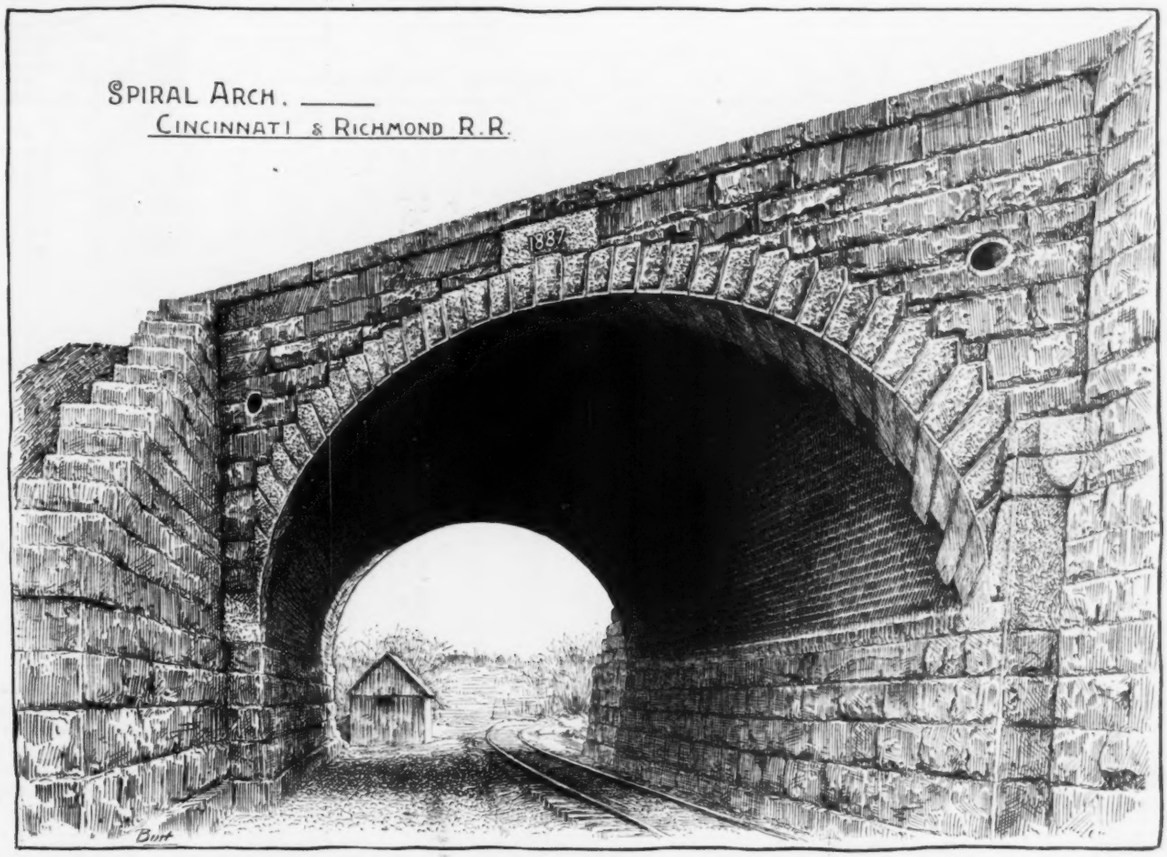
Test pits were sunk near the crossing to the water level in the creek, and then borings taken in these to a depth of about 12 ft. below water level; the result was, loam and earth to a depth of 6 ft., 2 or 3 ft. of blue clay, 2 ft. of coarse sand, then fine quicksand to bottom of boring. In view of the unstable character of the foundation, and importance of the structure, it was decided to have a pile foundation. It might be mentioned in this connection that two bridges over Duck Creek, one directly above and the other below the skew arch, have pile foundations. In digging the test pits, we found 5 ft. below ground surface, some flooring timbers of an old shanty which was used at the time of building the C., W. & B., in the year 1865: this is interesting as showing the amount of sediment deposited by overflows of the creek in a period of 22 years. The C., W. & B. embankment was cut through to a level with the original ground surface, and then the foundation pits proper to a depth making the top of timber below low water level of the creek; this made the excavation 45 ft. below the level of the C., W. & B. The method used to carry the traffic overhead without interruption was that of the alternate use of two pile trestles. To this end piles were driven for the main line trestle with a track pile driver. There were three piles to the bent, one in center of track and one at 5.5 ft. each side; the bents were 16½ ft. c to c, and in all 13 bents. The leads would not take longer than 30 ft. piles. The alternate trestle was 14 ft. from the main one c to c. The piles were driven with a land driver, and the location coming somewhat down the slope of the fill we were enabled to use 45 ft. piles. In case the location of the pile came within the limits of the masonry, the pile was not driven, but square timber substituted in the later construction. The caps were framed on the bents, the stringers slipped under the track, hewn ties replaced by bridge ties, guard rail, etc., without delaying travel. The stringers used were 10 in. × 20 in. doubled under each rail, and expected to carry the double span in case of emergency. The trestles were thoroughly braced as the excavation proceeded; the bents of the alternate trestle were of great service to the main trestle in making the sway bracing effective. When a depth of 27 ft. below the track was reached, the material directly under the main track was left standing, and that included between

*Reprinted from the *Journal of the Engineering Society of Lehigh University* Vol. III, No. 2.

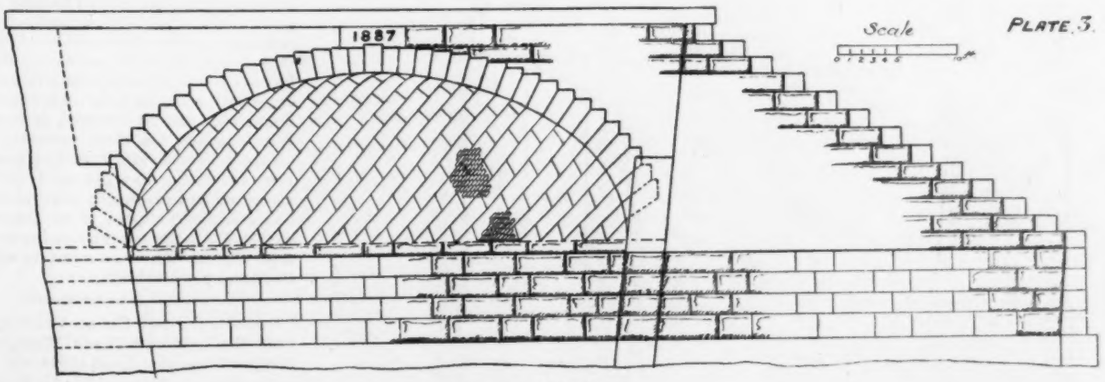
the rest of the abutments and the wings, was taken down to the natural ground level. A row of piles about 8 ft. apart was then driven all around and just clear of the foundation. The pits proper were then excavated to the required depth, sheeting being spiked to the piles as the work proceeded. Twenty and 25 ft. piles were first used, but later the length was increased to obviate the use of a follower which did not give satisfaction. The weight of the hammer used was 2,780 pounds, and with a fall of 25 ft. the average penetration under the last blow was 1¼ ins. The piles were then sawed off to a level bearing, and 10×12 caps bolted to them, running across the wing or abutment, the drift bolts used being of 1 in. square iron 16 ins. long. The intervening space was filled with well rammed concrete to a depth 8 ins. below the bottom of cap and until it flushed level with the top of the same. Four inch planking was then spiked to the caps lengthwise with the abutment. Several heavy storms and overflows of the creek caused considerable damage and delay in the way of filling up the pits and starting slides. Having built up the masonry to the springing line, and as close to the main trestle as safety would allow, travel was thrown over the alternate and the main trestle torn out. The pits were excavated for the rest of the abutments, and the masonry finished throughout to the springing line.

Plate No. 1 shows a general plan and location; Plate No. 2, a half section and end elevation; Plate No. 3, elevation of face and wing.

(TO BE CONTINUED).



General View of Spiral Arch with Brick Interior: C. & R. R.; from a Photograph.



FACE ELEVATION

English Railways in 1887.

The report of the English Board of Trade for 1887 shows the main facts in regard to railway operation for 1887 to be the following:—The receipts from goods traffic was nearly $5,000,000 in advance of 1886. The total receipts, including passengers, goods and miscellaneous sources amounted to nearly $355,000,000, or $6,755,000 more than in the previous year. The working expense has risen to an extent that leaves an increase in net earnings of over $4,000,000. The actual addition to capital was $88,140,000; yet the dividend paid on ordinary capital rose from an average of 3.94 to 4.08 per cent. The increase in ordinary capital was $47,500,000, or 3.1 per cent. during the year.

The report shows that the trade of the country is increasing and gives hope of better times yet in store. The total capital now invested in English railways amounts to $4,230,000,000, a sum exceeding the National Debt by $500,000,000. The dividends paid in 1887 amounted to about $175,000,000, a larger total than ever before paid. There are now nearly 20,000 miles of railway in the United Kingdom averaging in cost $215,000. On the average every 100 miles of railway has 79 locomotives, 179 passenger cars and 2,423 freight cars. Including vehicles of all kinds, but excluding locomotives, the total number is nearly 535,000.

The problem of the third class passenger becomes more pressing each year; and the party at one time almost ignored is now a power in the land. The

third-class receipts for 1887 were more than three times the first and second class combined. In number of journeys the third class was six times as numerous as the other two together, and in the last 11 years the receipts from the third class passengers have increased 31 per cent. while the first class has dropped 30 per cent. The number of first-class passengers has fallen nearly 27 per cent. and the third-class has increased nearly 45 per cent. In 1887 there were over 638,000,000 third-class passengers.

As showing the importance of the combined passenger and goods traffic the report states that the receipts from freight amounted to $185.00 per $5,000,000 of capital while the passenger traffic alone amounted to only $152.50 per same capital. The passenger trains in 1887 traversed nearly 152,000,000 miles run, and the freight trains over 128,000,000 miles.

The proportion of working expenses to the traffic receipts, which was as high as 54.1 per cent. in 1877, declined last year to 52.5 per cent. This is the same as in 1882 but less than any subsequent proportion.

ENGINEERING NEWS.

THE FISHER ELECTRIC RAILWAY at San Jose, Cal., is running well, carrying large numbers of passengers without a hitch.

A heavy casting has just been made by Carnegie, Phipps & Co., of Pittsburg, Pa., at their Homestead works. The casting is for the 42-in. cylinder of a 3,000 ton shear in the slabbing mill and weighs 54,600 lbs.

EXHIBITION OF DEVICES FOR PREVENTING ACCIDENTS.—An exhibition is to be held in Berlin, Germany, from April to June, 1889, of machinery, apparatus, etc., for preventing accidents, also drawings, models, copies of rules for factories, etc. Full particulars are given in a report by Consul-General F. RAINE, at Berlin, published in the volume of consular reports for May, 1888, recently issued by the Department of State, Washington. MAX SCHLESINGER, 3 Koch St., Berlin, Germany, is Secretary of the exhibition.

A SHIP RAILWAY, from the Bay of Fundy to Baie Verte, Gulf of St. Lawrence, is said to be contracted for by London parties. Mr. THOS. C. KEEFER is one of the Directors named in the act incorporating the Chignecto Marine Railway Co., and the above news is based upon a cablegram to this gentleman informing him that the contract has been practically settled. The estimated cost is $5,000,000.

THE Buffalo grade-crossings of the New York Central R. R. are to be abolished, if earnest work upon the engineering plans by Chief Engineer KATTE is any indication. The new plans follow closely the BUCHHOLZ scheme recommended by the experts a year ago, but do not include new passenger and freight depots. While this improvement will be the work of an individual corporation and not the combined work of all the roads interested, the New York Central is really the important factor in the desired end and the benefits will be great in proportion.

THE WESTINGHOUSE ELECTRIC CO. is rapidly becoming an immense corporation. Its latest absorption is the Consolidated Electric Light Co., of New York, whose property consists of a big manufactory of the Sawyer-Mann incandescent lamps in New York and in Pittsburg, with all their plant and stock. The use is given to the Westinghouse Co. of all the patents in its possession and the entire capital stock of the Sawyer-Mann Electric Co.; in return the Westinghouse Co. pays to the 150 stockholders of the Consolidated Electric Co., $150,000 per year, quarterly, equal to a yearly dividend of 4 per cent. until certain indebtedness of the Consolidated Company is liquidated, when the dividend will be increased to 6 per cent., and a royalty of 1 cent for every Sawyer-Mann lamp sold, which is expected to double the annual dividend of 6 per cent. The Westinghouse Co. also contracts to subscribe for the unissued stock of the Consolidated Co., now amounting to a par value of $125,000. Thus the agreement practically constitutes the Westinghouse Company trustee of the business of the Consolidated Co., the latter becoming merely an investment corporation, whose sole duty will be to transfer stock and pay dividends,

STEAMBOATS FOR CANAL TRAFFIC.—It is stated that the London & North Western Railway Co. (England) has abandoned the idea of laying lines of rails alongside its canal (the Shropshire Union) for the purpose of drawing canal boats by locomotive engines. The experiments conducted some time ago were regarded by the officials as fairly successful so far as they went; but the carrying out of the system along the whole length of the canal would be a very costly undertaking. The company's officials, however, believe that steamboats may be utilized on the canal, and some steel-plated boats, fitted with engines and boilers, are being constructed for the purpose. These small steamers will draw several barges, and although at places only a small speed can be maintained, still the saving of horses and drivers will form a considerable item toward the more economical working of the canal traffic.

The Weather of the United States for the Month of September, 1888.

[As respects the elements of most interest to engineers.]

According to special returns from the Chief Signal Officer of the U. S. Army.

STATIONS.	Temperature. Degrees Fah.				Wind velocity. Miles per hour.			Precipitation. Rain and melted snow. Inches.		
	Average	Max.	Min.	Range.	Average.	Max.	Direction. Max.	Total.	Heaviest in 24 hours.	No. rain days.
Northern Cities.										
Northfield, Vt	52.1	75.0	25.2	49.8	7.3	30	N	6.25	2.37	14
Portland, Me	55.2	77.7	33.2	44.5	6.0	33	NW	8.22	2.05	11
New York City	62.9	84.2	40.8	43.4	8.4	25	NW & W	7.41	1.64	15
Pittsburg, Pa	60.2	81.2	39.2	42.0	5.6	24	W	1.77	0.96	9
Chicago, Ill	59.6	88.2	36.	52.2	9.3	27	N & NW	0.98	0.45	6
Omaha, Neb	61.3	95.3	39.1	56.2	7.3	26	SW	0.24	0.09	5
St. Paul, Minn	55.2	81.2	30.9	50.3	5.6	28	SW	1.70	0.86	8
Duluth, Minn	53.8	78.2	35.1	42.1	6.6	24	SW & W	2.27	0.71	12
Bismarck, Dak	56.1	92.8	28.6	64.2	8.2	37	NW	0.33	0.31	2
Average	57.4	83.8	34.3	49.4	7.1	28.2		3.24	1.05	9.1
Southern Cities.										
Washington City	63	84	39	45	4	24	NW	6.82	1.63	14
Louisville, Ky	64.4	85.7	36	49.7	5.4	26	W	2.75	1.43	10
St. Louis, Mo	64.5	89.5	43	46.5	8.5	36	NW	1.31	1.14	5
Savannah, Ga	72.6	91.8	47.5	44.3	6.4	35	SE	10.34	1.98	17
Leavenworth, Kan	63.8	92.5	38.9	53.6	4.9	22	W	0.84	0.73	3
Jacksonville, Fla	74.4	92	55	37	.5	42	S	11.15	2.47	18
Chattanooga, Tenn	65.8	87.3	37.8	49.5	4.1	24	E	4.42	2.05	12
New Orleans, La	75.2	91	55.5	35.5	6.3	24	E & N	4.15	1.22	12
Memphis, Tenn	68	88	50	38	5	27	N	1.06	0.80	6
Palestine, Tex	71.8	90.2	52	38.2	7	22	N	0.27	0.20	4
Average	63.4	89.2	45.5	43.7	5.7	28.2		4.31	1.36	10.1
Western Cities.										
Helena, Mont	61.0	89	41	48	6.7	36	SW	0.14	0.68	5
Port Angeles, W. T	Not received.									
San Francisco, Cal	59.0	87.7	50.1	37.6	9.7	34	W	0.98	0.92	2
Salt Lake City, U	70.0	92.3	48.5	43.8	4.1	25	NW	0.51	0.45	4
Denver, Col	61.0	90	38	52	5.8	30	SE & N	0.11	0.08	6
Yuma, Ariz	88.2	110.6	66.6	44.0	5.4	33	S	0.01	0.01	1
Santa Fe, N.M	59.9	82.5	43.1	39.4	4	24	N	0.38	0.26	4
Average	66.5	92.0	47.9	44.1	6.0	30.8		0.36	0.30	3.7

PLATE 2.

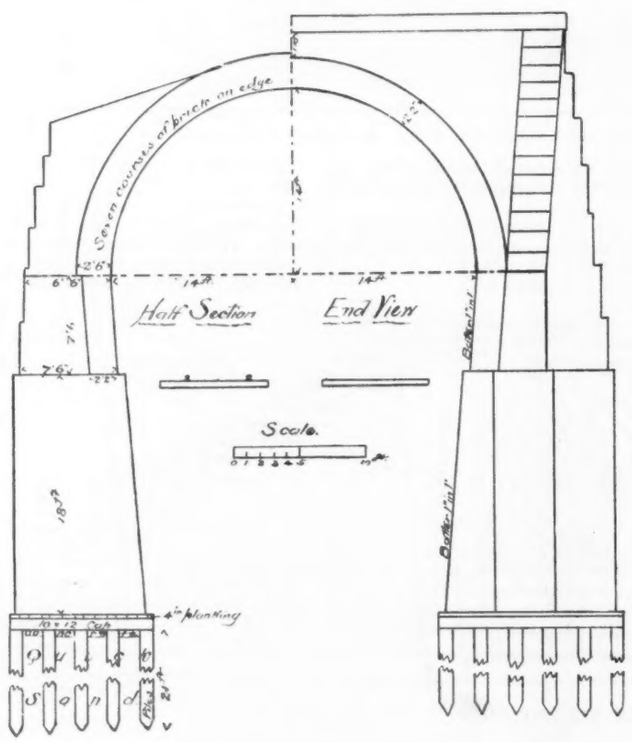


Plate 2, Skew Arch; Cross-Section.

The Walnut Grove Dam.

In our issue of Sept. 22, will be found a brief description of the Walnut Grove dam in Arizona in Mr. J. D. SCHUYLER's interesting letter on the subject of "Rock-Fill Reservoirs." We are now enabled, through the courtesy of BATES BROS., bankers of this city, and the original projectors of the enterprise, to present several views from photographs and also sketch plans showing some details of construction.

The dam is located on the Hassayampa river, about 30 miles south of Prescott in the State of Arizona. It is intended to store water for the development of the valley below by irrigation, and also to furnish hydraulic power for the working of extensive and rich gold placer beds some 17 miles distant. The natural formation was exceedingly favorable for the construction of a dam, as the site was at one time doubtless a rocky barrier impounding an original lake of great extent, a barrier that had been gradually worn away into a deep rocky gorge which emptied this lake. The projectors have simply restored this barrier, and the present dam will cover about 1,000 acres and store about 3,000 millions of cubic feet of water.

The photographs used explain themselves. The cross-section as given in sketch plans, intended to show the construction, does not quite agree with the slopes and dimensions given in Mr. SCHUYLER's letter; and as the latter are doubtless the most correct, we will adopt them as follows:—Height, 110 ft.; base width, 140 ft.; top width, 10 ft.; water slope 0.5 to 1 and back slope 0.6 to 1.

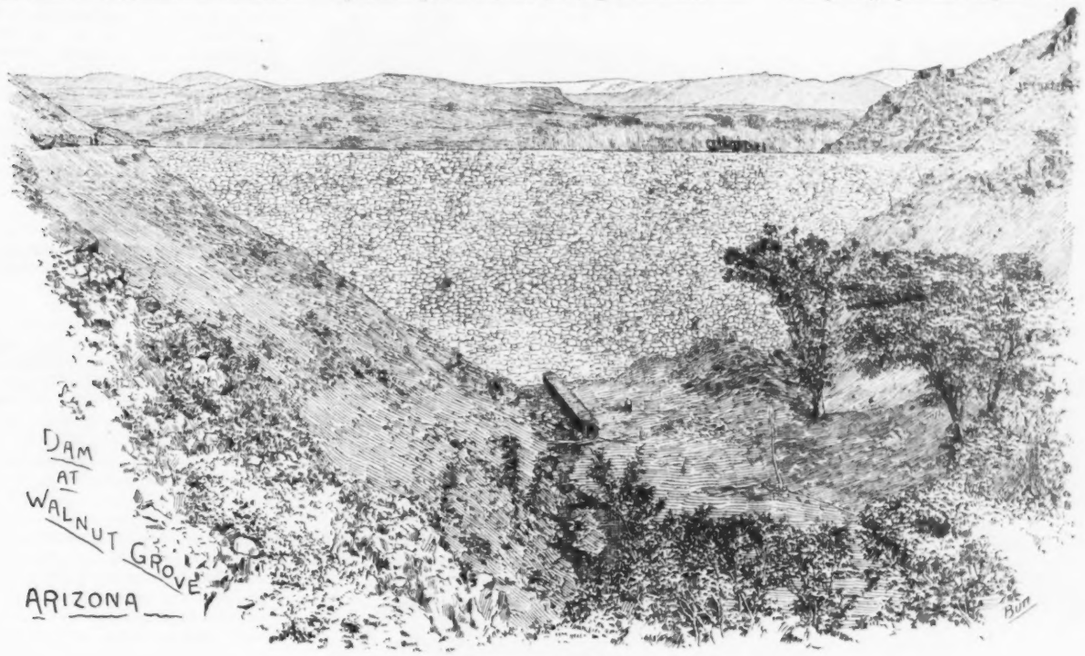


Fig. I.—Front Elevation, Walnut Grove Dam.

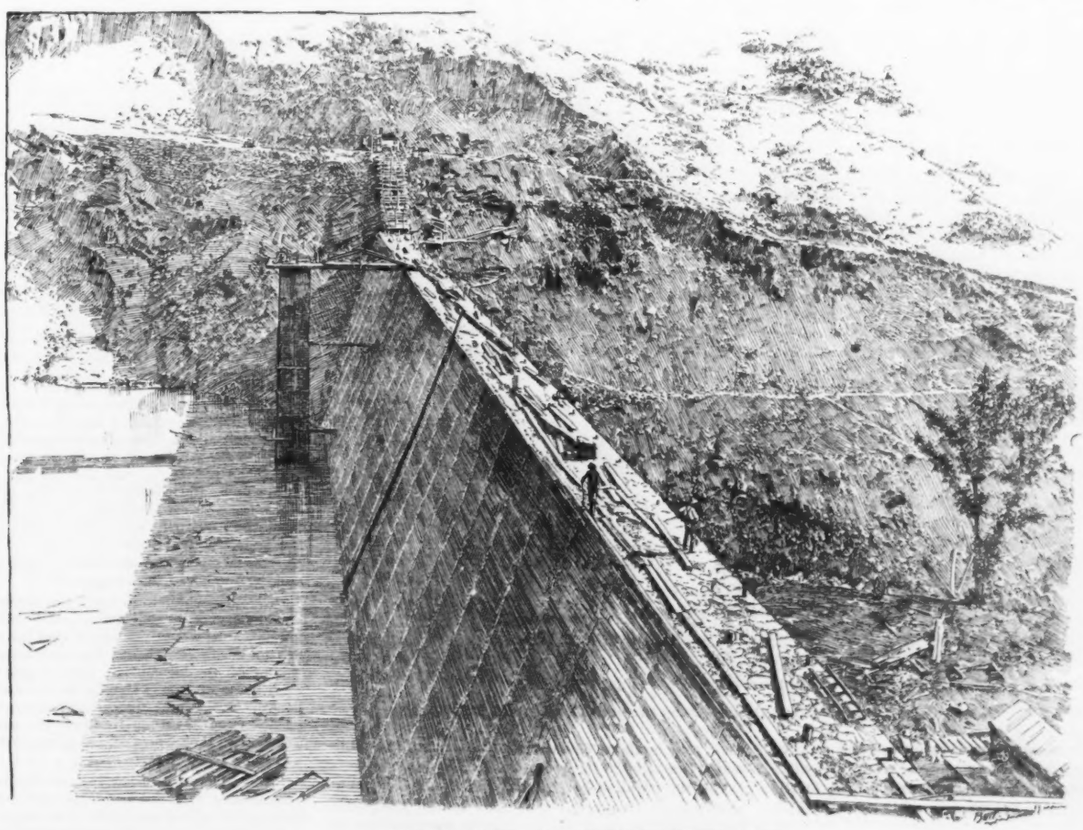


Fig. II.—View Across Walnut Grove Dam.

The material of construction was granite, blasted from the side hill above the crest level, as indicated in Fig. II. A timber trestle was built on the longitudinal axis of the dam and this was gradually raised as the work progressed, the timbers being left imbedded in the stone filling. The track on this trestle was reached by a steep incline (see Fig. II) and the stone-cars were lowered to the trestle track by a wire cable operated by a bull-wheel. This stone embankment was kept high on the center line to facilitate the selection and handling of the larger rock required for the face walls, which latter were laid up dry by the use of hand derricks, in the case of the heavier stone, and well bonded. The heart of the dam was wholly made of broken granite, as it was dumped from the cars.

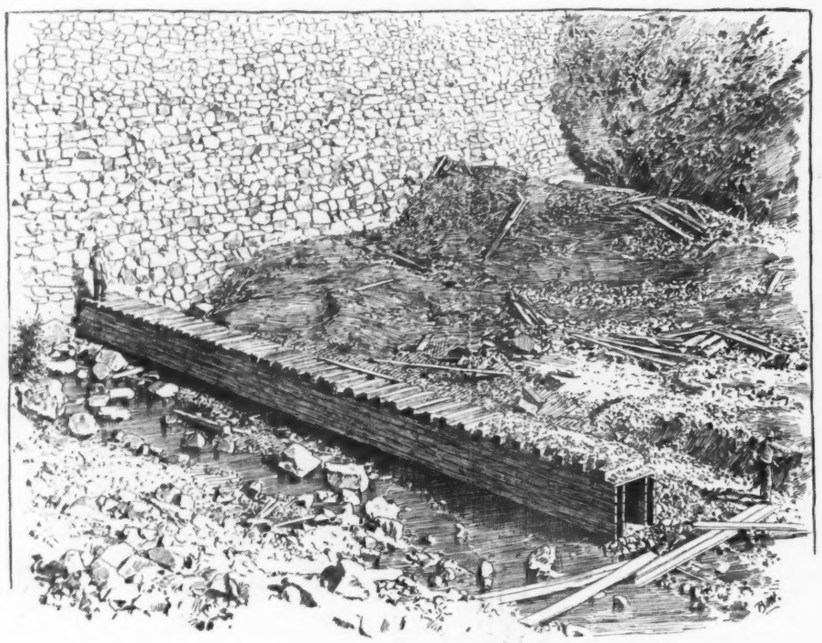


Fig. III.—Flume; Walnut Grove Dam; Showing also the Character of Masonry.

The water face of the dam was made tight as shown in Fig. V, 2. Cedar logs were imbedded vertically and about 6 ft. apart in the face masonry; to these logs were notched and bolted 8×8 ins. pine longitudinal timbers about 3 ft. apart in the clear and on these timbers was spiked a vertical sheathing of 3×8 in. pine planks well calked. On this sheathing was then placed a covering of prepared tarred paper, about ⅛ in. thick, and this was secured in turn by a horizontal sheathing of 3×8 in. pine. The outer sheathing was calked and pitched and then painted with two coats of paraffine paint. The result was a very tight wooden facing to the dam, not unlike in appearance to the great black hull of a ship.

The gate-house, shown in Fig. II, was 6 ft. square and built of timber; 20 ft. above the bottom of this gate-chamber were two square gates corresponding to two 20-in. iron pipes passing through the dam, and another opening 5 ft. square admitted water to the tower under certain emergencies. The iron pipes were imbedded in cemented masonry part of the way, but also passed in a small tunnel through a rock spur about the axis of the dam.

The flume (Fig. III) was also of wood with inside dimensions of 5 x 3 ft. It was provided with heavy outside frames (not shown in Fig. V, 3) and was imbedded in cemented masonry extending to the bedrock, throughout its length. The entire bed of the dam is in fact of cemented masonry for a height of about 10 ft. The gate to the flume is wood, of strong but simple construction, and it is operated by a rod extending to the top of the dam as shown in Fig. II. The waste-weir is blasted out the solid rock, and is about 6 ft. deep below the extreme high water line, and 26 ft. wide.

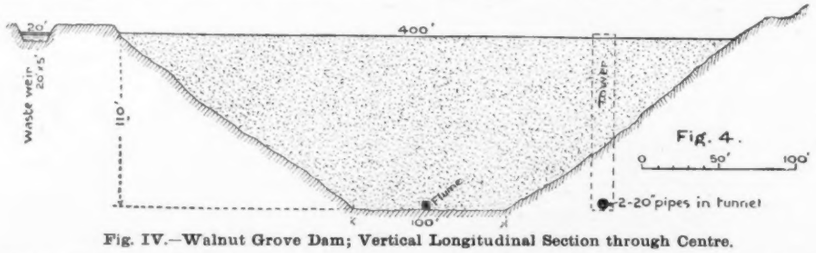


Fig. IV.—Walnut Grove Dam; Vertical Longitudinal Section through Centre.

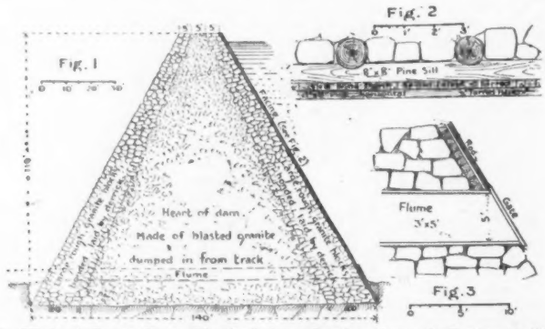


Fig. V.—Walnut Grove Dam; Vertical Cross-Section through Centre, and Details.

This dam leaked considerably as the water accumulated, as was to be expected; but it gradually became tighter, and this leakage is now reduced to a small amount. About 50,000 cu. yds. of stone were used in its construction and the cost, by contract, was $2.40 per cu. yd. as stated by Mr. SCHUYLER. In addition to the above amount about 12,000 cu. yds. were dumped over the front face from the excavation for the waste-weir.

As the surface of the dam is about 1,000 ft. above the placer working, the hydraulic head greatly exceeded any legitimate demand, and the expense of a 17-mile flume would have been greater than was necessary. Consequently this dam is devoted to storage only, and the company is now building another dam about 12 miles down stream. This supplementary dam is simply crib-work filled with stone, and it is 25 ft. high and 250 ft. long. From it a flume is started which will deliver water with a head ranging from 200 to 300 ft. at the placer beds six miles distant. The Hassayampa dam was originally designed by Prof. WM. P. BLAKE, the well known mining expert; but its execution was practically in the hands of the contractor and the projectors of the enterprise.

Lessons from the Recent Accident on the Paris, Lyons & Mediterranean Railway.

Judging from the reports in English newspapers, the derailment disaster which occurred in August last on the Paris, Lyons & Mediterranean Railway, is being closely investigated; more closely than such an accident would be likely to be investigated in this country. The accident may, however, produce a good result in the improvement of the locomotive in France by the more general use of the truck, as suggested in the report of the London *Standard*, which we quote below. According to that report a former serious accident induced this same railway company to adopt continuous brakes, and perhaps another accident may teach it new wisdom a second time. The locomotive in France, and on the European continent generally, is heavy in design and awkward in appearance. As a rule there is too much metal, and a tendency to complication in these engines, and the long rigid wheel base is still adhered to, although some few engines are fitted with a leading truck. A locomotive of the American type, if put on a French railway, would probably astonish many of their engineers as a novelty, since they are about 20 years behind England in locomotive practice, and have not yet begun the movement which is rapidly advancing in England to assimilate their locomotive practice to the American type.

The Paris, Lyons & Mediterranean Railway Co. have communicated the following note to the press concerning the accident at Velars:

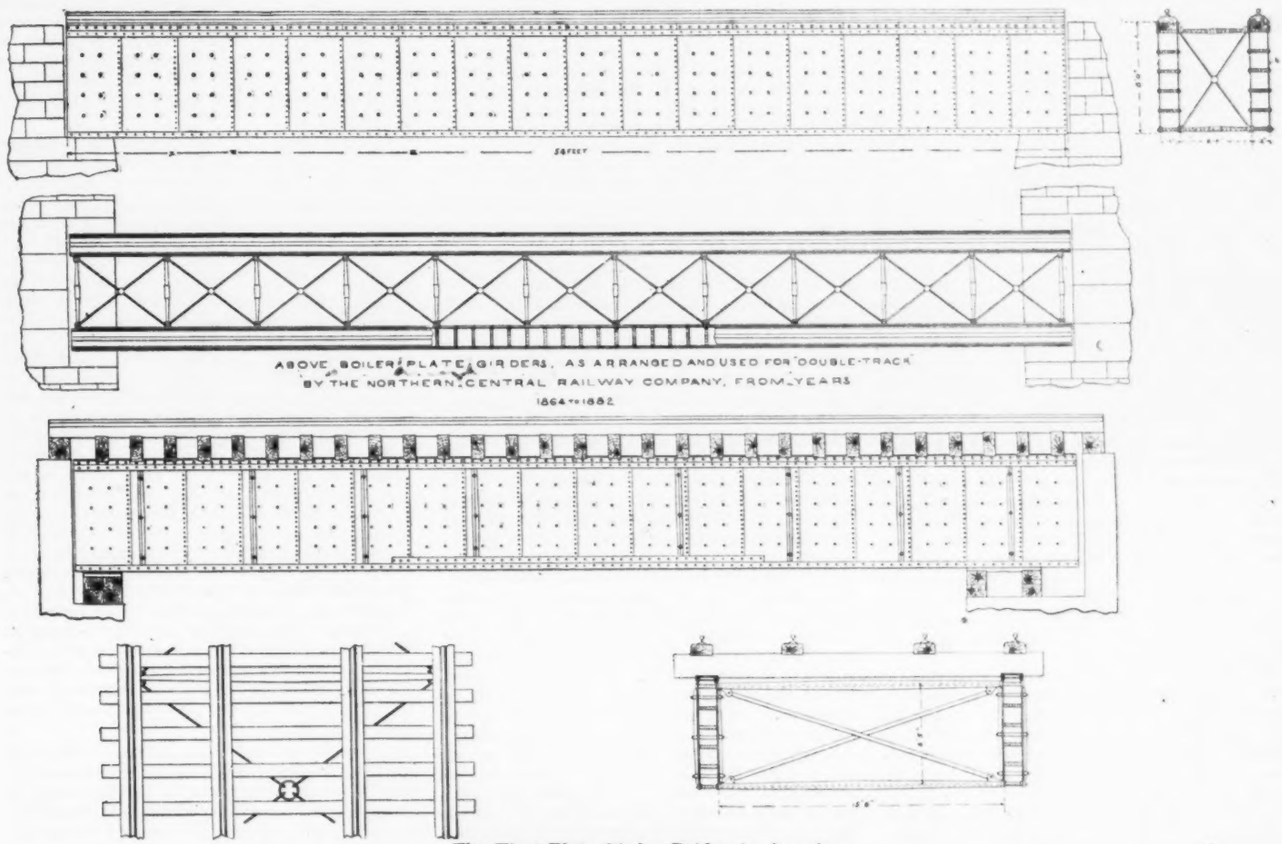
"'The first results of the inquiry made on the spot tend to prove that the cause of the train from Paris leaving the metals was a defect in the permanent way, caused either by the passing of one of the four express trains which had passed over the line between midnight and 2 A. M., or by the passing of the Paris express itself, to which the accident happened. Contrary to certain assertions, the permanent way was not under repair, and both the train from Paris and the train from Modane carried their usual officials. The number of passengers killed is 9 and the number of those injured 8.'"

"The representative of *La France* has questioned an engineer attached to the Ministry of Public Works. This public official would not admit that the permanent way had not been strengthened in proportion to the increased weight of the locomotive. Thirty years ago the rails were made of iron, weighing no more than 56 or 60 lbs. per yd. The weight these could support safely did not exceed from 5 to 6 kilogrammes per square millimeter The load on the springs of the locomotives at that time was about 22,000 or 24,000 lbs.

"This engineer asserted, that on this railway two descriptions of rails are employed, but both are of steel. The type of rail for the main lines weighs 78 lbs. per yd., and that employed on lines of secondary importance, 68 lbs. These steel rails can safely bear a load of from 8 to 10 kilogrammes per square millimetre. The maximum load on the springs of the big engines of this railway is from 28,600 to 31,000 lbs. Though this engineer is quite satisfied with the rails employed on this line, he is not satisfied with the locomotives. He says that nothing has

been done to facilitate their passing at great speed over curves without injuring the line. None of this company's engines are constructed on the bogie principle, so that, in passing over a curve, they turn simply by friction against the rail.

"The Lyons Railway seems to be very slow in adopting new improvements. It was not till the terrible Charenton accident, which occurred several years ago, that it was roused and compelled by public opinion to adopt the continuous brakes, which had for some years previously, been adopted by other companies. Notwithstanding that the company contends that the line was in a perfect state of repair, and that it was the object of daily inspection, it is now admitted that it was a defect in the permanent way and rails which caused the accident.


ABOVE, BOILER PLATE GIRDERS, AS ARRANGED AND USED FOR DOUBLE-TRACK
BY THE NORTHERN CENTRAL RAILWAY COMPANY, FROM YEARS
1864 TO 1882

The First Plate Girder Bridge in America.

Erected on Baltimore & Susquehanna (now Northern Central) Railway, 1846-47. JAMES MILLHOLLAND, Engineer.
Scale ¼ ft. per inch.

The First Plate Girder in America.

By the kindness of the son of the designer, Mr. JAMES A. MILLHOLLAND, General Manager of the George's Creek & Cumberland Railroad, we are enabled to present the very interesting cut herewith given of one of the earliest examples of American iron bridge construction, and one, it will be seen, which has rendered an excellent account of itself. The first two views show the bridge as originally erected; the lower two the same bridge as it was reconstructed for double track purposes in 1864, the bridge having remained in use until 1882.

The following letter, written by the designer to Mr. HERMAN HAUPT, soon after the erection of the bridge, gives many details which will be of interest:

READING, Pa., May, 1, 1849.

DEAR SIR:—Enclosed I send you the drawings of the three bridges I constructed on the Baltimore & Susquehanna Railroad while engaged as Superintendent of machinery and road. The one marked *A* was built at the Bolton depot in the winter of 1846 and 1847, and was put in its place in April, 1847. This bridge is made of puddled boiler-iron ¼-in. in thickness. The sheets, standing vertical, are 38 ins. wide and 6 ft. high, and riveted together with ⅝ rivets, 2¼ ins. from center to center of rivets. You will observe by reference to the drawing, that each truss frame is composed of two thicknesses of iron, 12 ins. distant from each other, and connected together by 5-16 iron bolts, passing through round cast-iron sockets at intervals of 12 ins.; which arrangement, together with the lateral bracing between the two trusses, ensured stability. The lateral bracing is composed of ¾ round iron, set diagonally and bound together at the crossing by two cast-iron plates about 4 ins. diameter, the sides next to the bracing being cut in such a manner, that when the two ⅝ bolts that pass through them were screwed up, it held them firmly together. There is also a bolt passing through both truss-frames and through the heels of the lateral bracing, at right angles with the bridge, which secured the heels of the lateral braces, and by means of a socket in the center made a lateral tie to the bridge, giving the bridge its lateral stability.

The lower chords were of hammered iron, there being some difficulty at that time to get rolled iron of the proper size, and are in one entire piece, being welded together from bars 12 ft. long. There are eight of them, 5 x ¾-ins., one on either side of each piece of boiler iron, and fastened to it with ¾-in. iron rivets 6 ins. distant from each other. There are but four top chords, and of the same size of the bottom, two on each truss near the top, the timber for the rail making up the deficiency for compression, and answering the purpose of chords. This bridge was built at the time Messrs. STEPHENSON and BRUNEL were making their experiments with cylindrical tubes preparatory to constructing the Menai bridge; the cylindrical tubes failing, they adopted this plan of bridge.

The entire weight of the bridge is 14 gross tons, and cost $2,200; but as the same kind of iron of which the bridge is composed can be had for at least 15 per cent. less now, than it cost at the time, it would be but fair to estimate the cost of the bridge at $1,870, without any reference to the labor that is misapplied in all new structures of the kind, making the cost of a bridge 55 ft. long, $34 per ft. And I have no doubt where there would be a large quantity of iron required for such purposes, that it could be had at such prices as to bring down the cost of bridges of 55 ft. length to $30 per ft.

Very respectfully yours,
JAMES MILLHOLLAND.

Mr. JAMES A. MILLHOLLAND says in a letter to this journal.

EDITOR ENGINEERING NEWS:

I send you by this mail a drawing I have had prepared of what is thought to be the *first* boiler-plate-girder bridge ever constructed. It was built by my father in the year 1846, when Messrs. BRUNEL & STEVENSON were experimenting with tubes for the construction of the bridge across the Menai Strait. These gentlemen subsequently abandoned the idea of using *tubes*, and constructed the bridge, as you are of course aware, of boiler-plate.

The plates were of ¼ in. thickness, and the whole bridge assembled, at first, as seen by the drawing. The iron lateral braces were, some years after replaced by wooden braces, and some years thereafter the girders were further separated, and the bridge adapted for a "double track," as shown also on the general plate.

It is of course with some pride that I refer to my father's early construction in railway plant, and particularly so with his identification with the earliest construction of a style of bridge now so highly recommended.

Yours very truly, JAMES A. MILLHOLLAND.

We are not prepared to state absolutely that this is the first plate girder railway bridge ever built, for it seems as if there must have been some in England or on the Continent, although we cannot put our hand on any record of them. At least, however, this was the first plate girder on this continent and almost the very first in the world, and its early date and subsequent creditable record gives it great interest.

As bearing on the question of the first use of the plate girder type, we find that in the English edition of Weisbach, 1848, Appendix II., it is stated:

"While the experiments on the tubular bridge were in progress, letters patent were granted to Mr. FAIRBAIRN for "improvements in constructing iron beams," in which he claims, "the novel application and use of plates or sheets of iron united by means of angle iron and rivets, or by other means, for forming or constructing by such combination, *hollow beams or girders* for the erection of bridges or other buildings. (British Association, 1846)."

"The idea of the tubular form is perfectly novel, and original with Mr. ROBERT STEPHENSON."

We judge from this that the plate girder type as we now know it was either so old at that time as to be well understood by engineers or had not been introduced at all. We must confess we do not know which, and are therefore reluctant to claim the girder illustrated as the first of its type. We trust some of our European subscribers will refer us to earlier plate girders, if such exist.

A CLASS in the theory and practice of steam engineering will be formed on the evening of Nov. 14, at the Young Men's Christian Association in New York. Those desiring to enter should send their names to Mr HANS P. ANDERSON at the Association.

CORRESPONDENCE.

The "Tunnel Excavation" Question on the New Croton Aqueduct.

TARRYTOWN, N. Y., Oct. 9, 1888.

EDITOR ENGINEERING NEWS:

Referring to the article in the editorial columns of your paper, issue of Oct. 6, 1888, under the heading of "Tunnel Excavation on the New Croton Aqueduct," if you will kindly permit, I desire to make the following reply. The article reads:

"As the same engineers drew up both of these contracts, it is not reasonable to suppose that in treating of so important an item as the area of tunnel excavation, they should have meant one thing for Sections *A* and *B* and something else for the remainder of one and the same tunnel, with almost equal lengths of work to be done in each."

However unreasonable it may appear, such is what was actually done. Previous to the letting of the work, contracts for the aqueduct, Sections *A* and *B*, were drawn up, advertised for bidders, and bids from contractors received for doing the work. These contractors were separately called in before the Aqueduct Commissioners and questioned as to their understanding of the terms of the contracts for Sections *A* and *B*, and asked to explain their bids. I had made out the bid in which I was interested, and had "put a round price upon the backing masonry," to compensate in part for the unavoidable excavation, exactly as you suggest in your article, and as a contractor who understood his business would do; my price in that bid was about $9.00 per cubic yard for backing masonry. When before the Commissioners, I claimed that I was justified in putting this price on the backing masonry; they maintained that I was not justified in so doing, that it was the intent that the city should pay for all the work necessary to be done, and, as one of these same commissioners has since remarked, "they wanted to provide a way to pay for all the work necessary to be done, but also wanted to provide some way to protect the city against the contractor digging a hole through to China."

The Aqueduct Commission shortly after this interview with the contractors declared all the bids off; and subsequently readvertised for bidders for this same work under the same form of contract and plans, and at the same time advertised for bidders for Sections 2, 3, 4, 5, 6, 7, 8 and 9, these latter are for brevity called the numerical sections. The contracts and plans accompanying the numerical contracts are of a later date than those of Sections *A* and *B* and the clauses in the numerical contracts relating to the tunnel excavation are worded entirely different from the the clauses in the *A* and *B* contracts. The plans are also different—different although the work to be done from point *D* to point *C*, under contract for Section *B*, was exactly the same as all the work under the numerical contracts. The form was the same, that is, horse-shoe shape, size of bore, the same conditions when completed and in use the same.

In contracts *A* and *B* the several classes of masonry are divided into what is termed "lining masonry" and "backing masonry"; any class of masonry when used as backing masonry is paid for at the rate of 85 per cent. of the contract price. In the numerical contracts the several classes of masonry are not divided into lining masonry and backing masonry; any class of masonry wherever used is paid for at the full contract price.

There is then plainly a difference between the systems adopted for paying for the masonry.

In Contracts *A* and *B* the line *A A A*, marked on the plans accompanying said contracts are used as a dividing line to designate what masonry shall be paid for as "lining masonry" or "backing masonry": it is also used in said contracts, in some instances, as the line by which the excavation is to be paid for. The *A A A* line in said contracts is named "Neat cross-section line of the tunnel excavation", to designate it from the cross-section of the tunnel excavation as shown on the plans.

The second part of clause 22, paragraph *F* of Contract *B* reads: "No payment will be made for any excavation outside of the neat cross-section line; and all loose or shaky rock must be removed."

The corresponding clause in the numerical contract reads: "No payment will be made for any excavation outside of the cross-section of the tunnel excavation determined by the engineer; but all loose or shaky rock must be removed".

The term "cross-section of the tunnel excavation determined by the engineer" and the term "neat cross-section line of the tunnel excavation", have an entirely different meaning. The term "neat cross-section line of the tunnel excavation" is nowhere to be found in the numerical contracts.

Clause 21, of paragraph *F* in contract for Section *B* reads: "What is herein to be known as the *neat cross-section line* of the tunnel excavation shall be a circle 14 ft. 11 ins. in diameter, as shown on Sheet No. 4, Fig. 1 of the plans, with its center at all points coincident with the center line of the aqueduct, as given by the engineer." The neat cross-section line of the excavation may be modified by the engineer from time to time whenever he finds it necessary to increase the size of the masonry. Modifications of the neat cross-section line of the tunnel excavation are illustrated on Sheets No. 4, Fig. 2, 4½ and 9, Fig. 1 and 2 of the plans. The masonry within the neat cross-section line, as above defined, shall be known as *lining masonry*, or *masonry* for lining, and shall be paid for at the prices stipulated in clause *O*. * * * "All masonry outside the neat cross-section line of the tunnel excavation shall be classed as backing masonry or masonry for backing. In each case the price paid for backing masonry is to be eighty-five (85) per cent. of the price paid for the corresponding class of lining masonry." * * *

The above quotation is entirely omitted in the numerical contracts. By referring to the plans mentioned in above quotation as illustrating the modification of the "neat cross-section line of the tunnel excavation", we find a considerable difference between each of the (untimbered) Circular Sections; a difference between a circle 14 ft. 11 ins. in diameter and a circle 16 ft. 8 ins. in diameter; however, as the following quotation from the same contract (*B*) will show, the contract gives the Engineer still wider latitude. From point *D* to point *C*, as shown on Sheet 2, of the plans, the aqueduct may be ordered of the form indicated on Sheets No 3, 6, 7, and 9, of the plans; and the neat cross-section line of the excavation is to be as represented on Sheet No. 9, of the plans, *or as may be directed by the engineer from time to time*. (Italics ours).

Does not the wording, "or as may be directed by the engineer from time to time"; give him the power to fix the "neat cross-section of the tunnel excavation", different from anything represented by the *A A A* line on the plans accompanying contract for Section *B*, and to make it conform to any shape or form he desires? Refer to Sheet 7, of the plans mentioned in above quotation; on it we find a horse-shoe shaped section and a sectional plan, they are headed "Aqueduct in Rock", "Tunnel with Weepers". We find on the section that the brick work is only 12 ins. thick instead of 16 ins. thick, as shown on Sheet 9, (which latter is referred to in above as being the sheet representing the neat cross section line) there is no note on Sheet 7, describing the *A A A* line as there is on Sheet 9; nevertheless, we find a corresponding line drawn 4 ins. outside of the brickwork and between the brickwork and the tunnel excavation which provides room for the weepers. The sectional plan shows a corresponding line running parallel with the sides of the tunnel, thus on plan 7, the "neat cross section line" being 4 ins. outside of the brickwork, consequently under the terms of the contract 4 ins. of the rubble masonry will have to be classed as lining masonry, also 4 ins. of the concrete under the invert. All the plans accompanying contracts for Sections *A* and *B* are drawn of such form that the *A A A* line is applicable to them as a pay line. We find also that these plans provide for different thickness of brickwork, and that wherever any excavation is ordered done by these contracts that the *A A A*, or a corresponding line, is drawn on the plans to include it.

The wording of the numerical contracts in relation to the tunnel excavation is so different, and some of the plans accompanying them are so different in design, etc., from the contract and plans for Sections *A* and *B*, that I cannot see how any person can sincerely claim (having both before him) that they mean one and the same thing. The fact of a line on the plans of each set of contracts being designated by the letters *A A A*, does not prove that the lines were meant for the same purpose, for it is a very common practice to mark lines with letters *A A A*. Suppose that the inner line shown on plans were marked with the letters *A A A* and a note on the margin of the plan read: Line *A A A* is the line of the cross-section of the tunnel *masonry*, and the contracts mentioned it as a limiting line, could it be inferred that no masonry was to be paid for outside of that line? No! On completed work on the numerical sections, the inner line on their plans is to the masonry, as the outer line is to the excavation, inasmuch as no masonry is to project inside the inner line, and no rock to be left projecting inside the outer line, and neither of them has anything to do whatever with the payment for masonry or excavation, and only intended as guidance for construction.

The *A A A* line is named differently; in the contracts for Sections *A* and *B* it is called "Neat cross-section line of the tunnel excavation"; on the plans for the numerical contracts it is called "Line of the cross-section of the tunnel excavation"; in the numerical contracts, the only mention made of it, is in the second part of Clause 17, which reads—"On the plans the line limiting the cross-section of the tunnel excavation is designated by the letters *A A A*." By referring to these plans, Nos. 8½, 9½ and 16, (which are the only plans on which the *A A A* is marked) we find that it limits or describes the outline of the least or smallest circular section, the least or smallest horse-shoe shaped section, and the least or smallest timber section shown on the plans; therefore it illustrates the last part of the following quoted sentence, Clause 17, which reads: "The form and area of the cross-section of the tunnel excavation at any place shall be such as the Engineer may determine for that place; but at all points it shall have an area of at least two hundred and one square feet (201)." By this clause the engineer is limited only, to not making a cross section of less area than 201 sq. ft., and the line *A A A*, named "Line of the cross-section of the tunnel excavation", on the plans is given to illustrate it. The aqueduct would not have answered the purpose for which it was intended, if it was smaller than that, and so the city guardians were very careful to limit the engineer so that it would not be made too small.

Such is the "bond;" if the contractors who trust to "Dame Fortune" and "the other original bidders" in being "too anxious or too confiding," or for any other cause did not see that the excavation was only limited one way; it certainly cannot now be considered unjust to them for the city to pay for the work as the contract provides. There is not a word in the contract to show that we shall not be paid for the unavoidable excavation outside of the *A A A* line, or outside of the name given it, "line of the cross-section of the tunnel excavation." Surely if it was the intent to limit the engineer in determining the cross-section of the tunnel excavation, it would not have been a less section than the section for Contract *B* between points *D* and points *C* of the aqueduct (as the work was similar in every respect). Compare section on Sheet 8 of the plans for Contract *B*, with section on Sheet 8½ of the plans of the numerical contracts and you will find the latter 8 ins. in diameter smaller. Surely if the *A A A* line was intended as a pay line it would have included the structural devices contemplated when the contracts were drawn, such as weepers on the numerical sections as it does on the *B* section. Compare the section and sectional plan on Sheet No. 7 of the plans accompanying Contract *B* with Sheet No. 7½ of the plans of the numerical contracts. Surely if it was intended as a pay line it would include excavation that the contract expressly provides shall be paid for. See section on Sheet No. 8½ of the numerical contract plans and you will find it does not do so. Surely if it was intended as a pay line it would have been applicable to the different plans. See sections on Sheets No's. 17 and 18 of the plans and you will find that it is not. Surely if it was intended to limit the Chief Engineer in determining the cross-sections of the tunnel excavation, the plans would have provided for brickwork of different thicknesses as was done for Section *B*. Surely if it was intended to be used as in Section *B*, the same plans would have been used to illustrate it; plans on Sheets No's. 16, 17 20, 21 and 24 of the

numerical contracts are not in the Contract *B* plans.

Turn to Sheet No. 24 of the plans and see how you would apply the *A A A* line payment theory to it; if the excavation for the space marked on that sheet filled with dry filling should be paid for under the contract, why should not the excavation for the space filled with dry filling on plans No's. 21, 20, etc., be also paid for?

Before the contracts were let, pointing to the section on sheet 8½ of the plans, which shows a section not lined with masonry, I asked one of the prominent engineers of the Aqueduct Commission, why points of rock could not be left to project inside of the *A A A* line, as they would only occupy the space that masonry would have done if the tunnel was lined. His answer was that if the tunnel was not lined with masonry, that to overcome the increased friction of the water running against the rough sides of the tunnel, he had mathematically demonstrated it would require the diameter of the tunnel to be nearly 2 ft. greater, so near, he added, that he made it exactly 12 ins. on each side, which is exactly coincident with the *A A A* line.

Another aqueduct engineer, who was prominent and had at that time considerable influence with the Commissioners, and who had them make several other important changes at his suggestion, was asked why it was that the numerical contracts were worded so differently from the *A* and *B* contracts. His reply was, that as soon as he got a copy of the *A* and *B* contracts he took them to the Aqueduct Commissioners and explained to them that the rock could not be cut out as if it were cheese, and that the matter should be left more in the hands of the engineers.

The Chief Engineer who drew the contracts, and under whom the work was conducted, in his report under date of Feb. 7, 1888, writes in regard to the *A A A* line as follows:

"The minimum section indicated by the line *A A A* on contract drawings, is given to guide the contractor in so placing their drill holes that the tunnel excavation may not be less and as little over the minimum section as is practicable. And again under same date he writes: "The contracts require that the engineers shall in all such cases determine the lines of cross-section to include unavoidable excavation outside of the minimum section given to guide the contractors in placing their marginal drill holes for blasting."

The *A A A* being the minimum cross-section line, the question may be asked —what protection had the city against the contractor "digging a hole through to China?" They had ample protection as the following will show: The Chief Engineer in his report under date of Feb. 8 1888, writes, "The contracts hold the engineer responsible for protecting the city against avoidable excessive excavation and amount of masonry caused by careless or unskilled blasting." The contract, clause 25, reads: "If in the opinion of the engineer, the contractor by the use of too high explosives, bad location of drill holes, defective arrangement of timbers or other support, or want of proper skill and attention, shall excavate the tunnel or shafts to greater dimensions than is required for the proper building of the masonry, the excess of tunnel or shaft area thus formed shall be filled solid at the expense of the contractor, with such kind of masonry (brick, concrete, or rubble masonry as herein specified) or other material as the engineer may direct."

The second part of Clause 21, in contracts *A* and *B* reads: "No payment will be made for any excavation outside of the neat cross section line; and all loose and shaky rock must be removed." In the numerical contracts it reads: "No payment will be made for any excavation outside of the cross-section of the tunnel excavation determined by the engineer; but all loose or shaky rock must be removed." Let us analyze and compare these quotations. As the "Neat cross-section line," in contracts *A B* is the name given to the *A A A* line, second part of clause 21 in contract *B* must mean that no payment will be made for any excavation outside of the line *A A A*. The quotation from the numerical "Cross-section of the tunnel excavation determined by the engineer," is not the name given to the *A A A* line in the numerical contracts, the cross section of the tunnel excavation as shown on the plans is an irregular line, and *A A A* line on the plans, or in the contracts show nothing more than that no rock shall be left to project inside of said *A A A* line; therefore the clause 21, in the numerical contracts cannot properly be interpreted to read that no payment will be made for any excavation outside of the *A A A* line. A comparison of the two concluding phrases of the sentences, will show conclusively, that the intent was that they should convey different meaning. In Contracts *A* and *B*, the words are "*and* all loose or shaky rock must be removed", in the numerical contracts instead of the word "*and*" being used to connect the two parts of the sentence, the word "*but*" is used.

WEBSTER gives the definition of the word *but* as follows;

1st.—Except, etc.

2d—Excepting, or excluding, etc.

3d—Otherwise than, that, etc.

4th—Only, etc.

5th—On the contrary, on the other hand, etc., and where used as connective of sentences or clauses of a sentence more or less exceptive or adversative.

The word *but* is also used in connecting both parts of the sentence in clauses 17 and 27, paragraph *F* of the numerical contracts, and in both cases means except or contrary to the preceding part of the sentences in which it is used, consequently I am justified in reading the second part of Clause 21 of the numerical contracts as follows:

No payment will be made for excavation outside of the cross-section of the tunnel excavation determined by the engineer, *except* all loose or shaky rock must be removed. It is a clause protecting the contractor; if it were not for this clause the engineer might determine on a cross-section of tunnel excavation which would not include the loose and shaky rock, under this clause the contractor is given the right to remove it and that he will be paid for it. In actual practice it frequently happens that by removing a portion of the loose or shaky rock, a section of less area than a timber section is got along with, thus saving to the City the cost of excavation and masonry. It sometimes happens, however, that the experiment of taking down or removing a portion of the loose or shaky rock to avoid timber section, results in making it much more difficult and costly to catch the ground, to put a timber section in it. When, however, the experiment is successful (oftener so than otherwise) the saving of time, of the area of excavation, and the area of masonry over that of a timber section is so great, that if the engineer had been cut off by the contract from making these experiments, it would have cost the City of New York hundreds of thousands of dollars more than the difference now in dispute; that is, if he were limited to allow payment to the contractor for only the minimum section and the timber section, with no mean section between the two which would include loose or shaky rock; in that case he would in justice to the contractor order all such ground, timber section, for he could not consistently have compelled the contractor to take all the risk of the experiments and the city to reap all the benefits and none of the loss.

Third part of Clause 21. Your article reads in regard to the third part of this clause. "This provision plainly, with almost brutal plainness, specifically includes in the price per cubic yard almost every contingency that would make necessary any excavation or rather removal of material from points outside the lines *A A A*.

There is not a single word in said clause or in any part of the numerical contracts that justifies the conclusion that this clause cuts off payment to the contractor for the material removed outside of the *A A A* line." It refers to material both inside and outside of the pay line, wherever that may be; it provides that "all expense" and "any expense" over and above the contract price per cubic yard, shall be borne by the contractor. Difficulties due to the presence of quicksand, boulders, rotten, loose or shaky rock that lie outside of the material removed, in practice, often cause the contractor more expense than the contract price for the material removed, and this clause entitles him to payment only at his contract price per cubic yard for the material removed. It would be brutal if it had the meaning you give it. It in no way intimates that payment is to be made only for the material inside the *A A A* line.

In certain cases, excavation has been made within the *A A A* line, through quicksand, rotten, loose and shaky rock which cost the contractor per cubic yard several times his contract price per cubic yard; in such cases this clause entitles him only to payment at his contract price. It would be nearly as fair as the meaning you give to it, to infer that wherever the tunnel was built through quicksand, rotten, loose or shaky rock and boulders, that the contractor would receive no pay at all for the excavation of it. There have been cases met with on the aqueduct, where owing to the presence of quicksand, rotten rock, etc., the excavation had to be made several feet below the grade of the tunnel in order to put in a suitable foundation to carry the aqueduct and the heavy overlying material, and for safety, and to enable the structure to be built on the line and grade selected for it, large quantities of the overlying material had to be removed outside the A, A, A line; and, although it cost the contractor a great deal more per cubic yard than his contract price, this clause entitles him to no more per cubic yard than his contract price.

Excavation in Dispute.—The excavation in dispute cannot be called "extra excavation" for Clauses 22, 23 and 24, of the numerical contracts explain what shall be considered extra excavation. It cannot be called "Excessive Excavation," for Clause 25 explains what shall be called excessive excavation. The only term of the contracts remaining for it, is "tunnel excavation," and the contracts provide we shall be paid by the cubic yard for tunnel excavation.

I observe that in your publication of my letter to you dated Sep. 26, 1888, you add a foot note, stating that the letter quoted by me and ascribed to the Chief Engineer is not published among the reports and documents presented to the late Senate Investigating Committee. By refering to my letter you will observe, preceding the quotation I wrote, "from which reports" and if you remember I explained to you that the quotation was from two reports, both under date of Feb. 7, 1887 and that, for brevity, I only quoted from each what was pertinent to the subject. You will find copies of both reports from which I quoted in a pamphlet issued by the Counsel to the Corporation in the year 1887.

DUNCAN D. MCBEAN.

[We have given our correspondent's letter in full, notwithstanding the space occupied, as it was drawn out by our own editorial, and we preferred not to assume the responsibility of an abstract. We cannot spare the space to answer in detail the arguments advanced, for they would be unintelligible to our readers without a reproduction of the many diagrams referred to. But on careful consideration we still fail to see that there was any difference in *intent* between the two sets of contracts, whatever there may evidently be in the wording. Our correspondent admits that in *A* and *B*, the *A A A* line "is used in some instances as the line by which the excavation is to be paid for", and it is only logical to assume the same intent for the numerical contracts. We have before stated why we thought the contracts very properly limited the powers of the Engineer to fixing the dimensions of the tunnel as called for by its several uses only, and see no reason to change that opinion. The truth of the matter is, that we recognize very familiar ear-marks throughout these contracts, as pointing out the handiwork of certain well-known engineers, and we know perfectly well what the law and intent was of previous similar documents drawn up by these same men. But according to the testimony before the Senate Investigating Committee, so many entirely different parties laid claim to the parentage of these documents that they may well have been botched in the handling, from a legal standpoint. We read and interpreted them as an engineer and without prejudice against either party. If room has been left to fairly build up a legal fight upon the meaning of words, we must leave this portion of the controversy to the profession that knows so well how to take advantage of similar trifles.—ED. ENG. NEWS.]

ENGINEERING NEWS

AND AMERICAN RAILWAY JOURNAL

Published Weekly at Tribune Building, New York.

VOL. XX. Saturday, October 20, 1888.

D. McN. STAUFFER, A. M. WELLINGTON. EDITORS.

GEO. H. FROST. - - - - - BUSINESS MANAGER.

Subscription. — UNITED STATES AND CANADA, $5.00 *per Year; $2.50 for Six Months; $1.50 for Three Months; Single Copies,* 12 *cents.* FOREIGN COUNTRIES, $6.56 *per Year, or* 3 *cents per number additional.*

Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also,* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

Drawings for publication *should preferably be in plain black and white, considerably larger than they are expected to appear, with letters and figures in pencil only, all lines clean and bold.*

Coming Technical Meetings.

Engineers' Club, Philadelphia, Pa.—Regular meeting, Nov. 3. Secy., Howard Murpoy, 1122 Girard St.

Civil Engineers' Society of St. Paul, Minn. — Regular meeting, Nov. 5. Secy., Geo. L. Wilson, City Hall.

Engineers' Club of Kansas City, Mo.—Regular meeting, Nov. 5. "Electrical Railways", T. F. Wynne. Secy., Kenneth Allen, Y.M. C. A. Building.

American Society of Civil Engineers, New York.—Regular meeting, Nov. 7. Secy., John Bogart, 127 E. 23d St.

Civil Engineers' Club of Cleveland, O.—Regular meeting, Nov. 13. Report on Mechanical Engineering. Secy., James Ritchie, Case Library Rooms.

National Association of Brickmakers.—Annual meeting at Memphis, Tenn., Nov. 13, 14, 15.

Engineers' Society of Western Pennsylvania, Pittsburg, Pa.—Regular meeting, Nov. 20. Secy., S. M. Wickersham, Penn Building.

Boston Society of Civil Engineers, Boston, Mass.—Regular meeting, Nov. 21. Secy., S. E. Tinkham, City Hall.

THE opinion of Corporation Counsel BEEKMAN that $738,390 has been improperly allowed to the contractors outside of the required clear cross-section of the new Aqueduct tunnel, and must be recovered from them, is in accordance at one and the same time with the letter of the contract, with reason and justice, and with the practice of engineers, among whom the practice that no *excavation* shall be paid for outside of the required clear cross-section, but that the masonry, timber or other back filling required to fill up the void, shall be paid for, is well established. As Chief Engineer CHURCH well remarks, if he is correctly quoted in the daily press: "This is not a question of law, but of engineering", and the quibbles of any number of lawyers, if they were contrary to the established customs and precedents of the profession, and to reason and justice as well, ought not to and probably would not stand. But this is very far from the case. In some cases it is provided that unexpected and, in the engineer's judgment, unavoidable falls and slips shall be paid for extra, but on no work that we ever heard of was it permitted to the engineer to allow regularly and normally for extra material removed throughout the length of the tunnel, either by exact cross-sections, or by what is the same thing in effect, assuming a larger average cross-section. In order to have any clear cross-section it is a well understood and unavoidable necessity that a considerably reater actual cube should be taken out, and contractors always allow for the fact in bidding, but to pay for this unavoidable work, even when there is no lining to be put in, is simply putting a premium on bad work and reckless blasting. When in addition there is a masonry lining to be put in at a pretty high price, paid on all the actual volume put in, it becomes a monstrous absurdity that the contractor should first be paid a high price for creating a useless void at little or no actual cost to himself (and usually even a saving) and then be paid another high price for filling the void his own recklessness created, so making a second profit out of his own sins and shortcomings, which under such conditions are hardly likely to oppress his conscience, or grow less with time.

WE think it but fair to call the special attention of engineers practically familiar with the latest grain-elevator practice, and of manufacturers of elevator plant as well, to the want notice which appears in our advertising columns in regard to an engagement in Russia. Several large elevators are, we believe, proposed in Odessa, which it is naturally desired shall include all the latest improvements.

THE use of the spiral arch in spanning openings oblique to the axis of the line belongs practically to the infancy of railroad construction, and many beautiful examples of this class of structure exist on the railroads of England and the Continent, and in a few cases on the early railroads of this country built under English influence. The introduction of iron trusses and plate girders soon provided a much cheaper and quite as efficient crossing, and the skew arch disappeared. The late tendency to return to the stone arch for all small openings has called renewed attention to this form of construction; and the absence of any published data on this subject other than the somewhat antiquated works of BUCK and a few others, is sufficient warrant for republishing the paper commenced in this issue, and presenting in full the details of construction of one of the latest arches of this kind built. The chief reasons given for the return to stone on our trunk lines is the decreased cost of maintenance, which in time offsets the original greater cost, and the fact that the surplus strength of the stone arch provides better than metallic superstructure in small spans for the ever increasing concentrated load on bridges.

WE call the attention of all interested in water-works construction or securities to the communication from DuBois, Pa., which is given on the last page of our water-works news. DuBois is without a system of water-works, although its population is now 7,000, and the borough is ready to rent fire hydrants, and contracts can be secured from 500 consumers for the first year, if some capitalist will put in works. It is surprising to learn that so large a town should still be without water-works when hundreds of smaller places are already supplied, and when water-works contractors are seeking every available opportunity to put in works, oftentimes under far less favorable circumstances.

THE cave-in of the West Point tunnel, noted elsewhere, was peculiar in the clear indications it gives that the tremor of the train was the direct cause of the fall taking place precisely when it did, just when a train was passing. The fact that the engine and first half of the following car escaped is almost proof positive of this, since the fall was on time to a second if it was provoked by this cause; whereas otherwise, there was no reason why it should fall in that second rather than in any one of the 863,999 others in a day. Had the fall taken place a few seconds earlier, so as to wreck the engine, the result, perhaps would have been far more disastrous, especially had the boiler been ruptured. It has several times been made apparent that a tunnel is an excellent place for parboiling passengers under such conditions.

The incident affords new evidence that it is best to keep tunnel linings under frequent inspection and not delay repairs too long. Also that the lining and backing when originally constructed should be planned and executed with all thoroughness; for if a fall does occur, it is likely to come when it will do the greatest damage.

IT is perhaps merely a coincidence that last week's great accident on the Lehigh Valley should have been to a double-header train, the rear engine only being connected with the train brake, as was the last preceding great accident, at Chatsworth, Ill., 14 months before; but we cannot but believe it is something more than a coincidence; an illustration in both cases of the danger of that system of handling trains. The use of two engines is at times unavoidable, but there can in no case be necessity, nor can we perceive excuse, for running two engines together with only one of them connected with the air brakes. It is a very simple and inexpensive matter to run a pipe forward to the front end of the engine and provide it with a coupling, and then, by a long coupling hose if necessary, connection can be made at any time, and if not used but once a year, no harm is done.

When the secrets of all hearts shall be revealed, we suspect it will be found that in both these great accidents the catastrophe would have been avoided had the train been shorter and hauled by one engine, having resulted from these causes: both engineers were more careless than usual, the one ahead because he had no control of the brakes and was only a helper, the one behind because he could not see so well, and trusted to the one in front, and both alike because they had only half of their usual responsibility. Nevertheless the head man saw the danger first, and endeavored without success for some little time to attract the attention of the man behind, who alone controlled the brakes. Finally, when the latter was at last awakened to the necessity, and put on the brakes, the engine ahead, being without brakes, so reduced the average efficiency of the brakes which were on, that the train did not stop in time. Even if the engine ahead had reversed, that goes but a little way to supply the absence of brakes.

THE use of a steel rod in testing masonry and the detection of vacancies in this masonry by means of the sound returned is not so new as some of the readers of our last week's article on bad work on the New Croton Aqueduct might infer. That veteran among American engineers, the Hon. WM. J. MCALPINE, tells us that 35 years ago he used a practically similar testing apparatus in inspecting the masonry in his charge on the Erie Canal. In his case a small steel rod was used as a walking stick, and a tap on the top of any stone laid soon told him whether it was properly "backed-up", or whether a hollow existed beneath. He provided all his inspectors with a similar cane, and the result was a very general respect among the masons for this simply applied test, and a marked improvement in the character of the work.

As was to be expected, several correspondents have written to us that they have used

the method of keeping field-notes of curves, which has recently been brought out and recommended in these columns. Some of them say they have used and proved it for twenty years, and we have no doubt correctly. It is only to be regretted that they have not taken steps to make it more generally known. It has seemed unnecessary to publish all these letters, as the pressure on our space is now great.

IN commenting two weeks ago upon the scheme presented to the New York County Medical Society for an "Additional Water Supply to New York City", we confounded it with the Ramapo project in our query as to water rights. This is incorrect; the two schemes are entirely distinct. The Ramapo water-shed is wholly within the boundary of New York State, as is the pipe-line location leading to New York City. And while the stream is one of the upper feeders of the Passaic, the water would be collected in a region outside of the jurisdiction of the State of New Jersey. In its utilization, provision has been made for at all times allowing a flow in the Ramapo equal to the warm weather supply; and as this stream in New Jersey has a broad flat valley presenting no natural conditions for storing water, no complaint should follow a diversion of storm water which cannot be gathered and saved within the limits of the State across the North River.

EVERY regular traveler over a draw-bridge in New Jersey has had occasion to become aware of the fact that trains have always been obliged to yield the right of way to craft of every description. The Legislature of that State, in 1881, passed a bill seriously affecting this privilege inasmuch as it grants, according to high legal opinion, the train the right of way. This law is now being practically tested by the Erie Railroad, which, at its new draw crossing the Hackensack, has placed in position the signals required by the law, which constitute a veritable new departure. On the draw, 30 ft. above the upper chords, is a signal ball 2½ ft. in diameter, which, when hoisted to the top of its staff, signifies that the bridge is closed and approaching vessels are thereby warned to keep away. At each side of the draw, 500 ft. distant, are signal posts bearing the following inscription in large block letters

N. Y. L. E. & W. R. R.
Distance Post.
500 YARDS FROM DRAW BRIDGE.
Look out for ball signalling trains, Boats forbidden to pass Post while Signal Ball is hoisted.

The post consists of four piles driven in a cluster and strapped and bolted together. From the center of the cluster rises a standard carrying the board and surmounted by a lantern for use at night. The posts are located away from the channel, so as not to interfere with navigation, and yet are in plain sight of pilots. The absurdity of the old custom, which permitted a cat boat manned by the owner to delay indefinitely several trains, is apparent. Hundreds of passengers daily have been kept on the anxious seat waiting for the draw to close, to permit the most insignificant craft to pass; and upon a road operated by block signals, like the Erie, the delay often affects trains miles from the draw.

It is to be hoped the law will stand, and this new precedent become established; but what between the National control of navigation, and the old common law precedents in its favor, which have come down for ages past, it cannot be regarded as certain.

Street Paving Guarantees.

In our issue of Oct. 6, we briefly answered the queries of a correspondent in regard to the justice and advisability of demanding a time guarantee from contractors for street paving and the retention of a percentage of cost. We then had only a general query to answer, but later information shows that the question originally applied to the city of Cleveland, O., and that the Mayor and City Civil Engineer of that city have reported against a proposed ordinance calling for a 10 year guarantee on "the laying of any pavement" and the retention of 10 per cent. of the contract price to secure this guarantee.

While the proposed ordinance is not drawn up perhaps in the form best adapted to secure good pavements, some of the objections made to it in the report can be questioned. This guarantee feature is very common in England and on the Continent, and when the excellent condition of foreign streets, as a rule, is compared with roadways in our own cities, which are bad as a rule, there would seem to be virtue in the system somewhere. As variations on this plan, it might be noted that in London wood pavement contracts sometimes require from the contractor 2 to 3 years "free maintenance;" but then the Corporation enters into a contract with the same party to pay him a certain price per square yard for current repairs for a further period of 15 years. A similar system is now in operation in Paris in regard to sheet asphalt pavement; a former system whereby the contractor received his principal in annual instalments extending over 18 years, having been practically abandoned as resulting in a very costly and yet improperly maintained pavement.

The point made in the report that there should be a distinction made between pavements laid with materials purchased in the open market and those put down under conditions barred by patents, etc., seems to have little to do with the question. The patent pavement would probably not be used at all unless it was deemed better for immediate use, and more economical in the end than a common pavement. And it is rather a protection to the every day contractor than otherwise, to compel the advocate of a patent pavement to back up his faith in its good qualities with a time and money guarantee.

The point made that block pavement may be laid under certain conditions without "costly foundations" is true in the existence of such pavements, but is false in the light of good practice. The lack of a substantial and unyielding base to our street pavements as a very general rule is literally at the bottom of all the trouble, and explains the short life and wretched condition of much of our paving. Such foundations are costly, and in the case of a new street liable to frequent breakage of surface for underground work it may not be advisable at first. But if a really good surface is wanted, with all the other advantages this condition implies, a good foundation is the one thing absolutely necessary. It is, after all, a question for the people to decide whether, all things considered, it is better economy to pay for a poor new pavement about every 5 to 8 years, and in the meantime to suffer all the annoyances and expense of ruts and hollows and frequent repairs; or to pay more for a good pavement at the start and possess that which is a credit to their city, a pleasure to themselves, and a pavement that, taking reduced maintenance expenses into consideration, will probably cost little if any more in the end than the cheaper but less satisfactory type.

The charge that the retention of a large percentage of their capital is an injustice to the smaller contractors and may drive them out of the business, does not agree with the older charge that "corporations have no souls". Such consideration may be charitable and proper in an individual, but public works should know no individual, when public money is to be expended for the general good. The interest of all demands that the corporation should get the most and best attainable for the money entrusted to it to spend; and if the requirement of a time guarantee and the withholding of a certain amount of money for a certain time will secure better work, even at a slightly increased first cost, it is the plain duty of the authorities to exact these guarantees even if some local individual contractors should suffer. But we do not believe the worthy would suffer. The contractor who takes a large and costly contract on a margin of cash so limited as to be really embarrassed by the retention of the percentage is hardly a desirable man for the city's interest. The same general poverty implies the purchase of materials on disadvantageous terms and the increased necessity for economy in every direction in his hand-to-mouth enterprise; an economy, in fact, that will rarely result in profit to the city in the character of the work performed.

It is not the intention to exclude the more humble contractor from public work; for there are always lesser jobs in abundance that may be relatively as profitable, and are yet well within his means of execution. Every prominent contractor has commenced with the lighter work, and the wise and successful man has not allowed his ambition to run away with his common sense by assuming work under conditions that were liable to cripple him financially. The ordinance referred to proposes to invest the retained percentage in interest-bearing securities; and even if the enforcement of such a law should abstract "$20,000 in 4 years, or $100,000 in 10 years" from contractors who have done work in Cleveland, as the report suggests, this hardship would not be great to the men properly equipped for doing good work on the scale indicated. Of course, if their reserve is to be all expended in making faulty work good, it would be a serious drain upon the capital and the profits; but in case this was necessary, the ordinance imposing such a guarantee should be regarded as a sound and wise precautionary measure, and one sorely needed for the protection of the public.

The Water-Works of New England.

II.

USE OF METERS.

The use of meters is very common in the New England States compared with most of the others, some of them having an enormous number in use, as shown in Table 14, which gives a list of all the towns which report 100 meters or over in use. These works, however, only number 31, with 36,111 meters in use, and 99 others with less than 100 meters have only 1,802, or an average of 18 each, while 157 water-works report no meters in use. Probably quite a number of these latter have more or less meters in use and have simply failed to report them, but all the towns having any large number of meters, we are confident, are included in our list.

A fact of even more significance than the absolute number of meters, however, is the proportion of meters to taps, and in the lower part of Table 14, this proportion is given for all the works having more than one-sixth of their taps metered, 22 in all. Two towns, Brunswick, Me., and Barrington, R. I., have all their taps metered, but with the small

TABLE 14.

NEW ENGLAND WATER-WORKS REPORTING OVER 100 METERS IN USE.

	No. Meters.	To'l for State.		No. Meters.	T'l for State.
MAINE			Lawrence	918	
Portland	152		Springfield	472	
Brunswick	210		Newton	2,370	
7 others	111	473	Taunton	782	
			Brockton	1,200	
(33 without meters)			South Abington	130	
NEW HAMPSHIRE			North Attleboro	200	
Manchester	750		Whitman	126	
10 others	108	858	55 others	1,079	23,964
			(57 without meters)		
(19 without meters)					
			RHODE ISLAND		
VERMONT			Providence	7,623	
Burlington	374		Pawtucket	2,000	
4 others	15		Woonsocket	674	
		389	6 others	144	
(18 without meters)					11,341
			(7 without meters)		
MASSACHUSETTS					
Boston	3,114		CONNECTICUT		
Worcester	6,854		Hartford	315	
Cambridge	219		Norwich	100	
Boston (Mystic system)	420		Waterbury	128	
New Bedford	102		17 others	345	888
Salem	198				
Fitchburg	600		(23 without meters)		
Lowell	1,430		SUMMARY		
Lynn	230		31 works with over 100 meters		36,111
Attleboro	328		99 " " under " "		1,802
Holyoke	149		157 " without "		
Fall River	2,941				
Brookline	156		287		37,913

PERCENTAGE OF METERS TO TAPS IN VARIOUS NEW ENGLAND WATER-WORKS HAVING A LARGE NUMBER OF METERS, INCLUDING ALL THOSE WHICH HAVE MORE THAN ONE-SIXTH OF THEIR TAPS METERED.

Towns.	Per cent. of taps metered.	Towns.	Per cent. of taps metered.
Brunswick, Me.	100.0	Brockton, Mass.	57.1
Manchester, N. H.	24.2	S. Abington, "	52.0
Burlington, Vt.	16.7	N. Attleboro, "	42.4
Boston, Mass.	5.6	Whitman, "	63.0
Worcester, "	84.3	Middleboro, "	21.3
Fitchburg, "	27.2	Norwood, "	20.6
Lowell, "	19.2	Providence, R. I.	58.1
Attleboro, "	43.5	Pawtucket, "	60.4
Fall River, "	70.0	Woonsocket, "	88.5
Lawrence, "	21.2	Westerly, "	47.2
Newton, "	63.0	Barrington, "	100.0
Taunton, "	27.1	Hartford, Conn.	5.4

TABLE 15.

NEW ENGLAND WATER-WORKS.—HYDRANT RENTAL.

(Nearest even $5 taken.)

Hydrant rate.	Me.	N. H.	Ver't.	Mass.	R. I.	Conn.	Total.
Free	4	—	—	8	—	2	14
$ 5	—	—	1	—	—	—	1
10	—	—	1	5	—	—	6
15	1	1	1	4	1	3	11
20	—	1	—	7	—	3	11
25	—	2	—	3	—	2	7
30	1	1	2	5	2	6	17
35	1	3	1	3	—	—	8
40	5	—	—	6	—	2	13
45	1	—	—	3	—	—	4
50	8*	2	1	6	—	1	18
Total	21	10	7	50	3	19	110

* One of these Maine works received $63 and another $75 per hydrant.

numbers of 210 and 30 taps. Woonsocket, R. I., with 761 taps, has 88½ per cent. of them metered, and next comes Worcester, Mass., with 8,110 taps, of which 84.3 per cent. are metered. On the whole Worcester may be considered the banner town of New England, if not of the Union, in this respect, but several other large cities have a very large proportion of taps metered. Boston has 3,534 in use on both its systems, but the proportion to taps is still small. Providence, R. I., has the largest aggregate, 7,623, but the percentage to taps is only 58.1.

HYDRANT RATES.

Table 15 gives a summary of these, so far as reported, for 110 water-works, which includes a large proportion of those which have such rates, being those works only controlled by private companies. The most common rates will be seen to be $30, $40, and $50, but 50 works out of the 110 report less than $30. The highest rates are in Maine, where they were doubtless given to encourage the construction of works.

TABLE 16.

NEW ENGLAND WATER-WORKS.—PUMPING MACHINERY.

Makes of Pumps (arranged alphabetically).	No. of Pumps.							Capacity, Millions of Gallons.						
	Me.	N.H.	Vt.	M'ss	R.I.	Ct.	T'tal.	Me.	N.H	Vt	Mass.	R.I.	Ct.	T'tal.
Blake	4	1	—	16	—	—	21	5.2	1.0	—	15.2	—	—	21.4
Corliss	—	—	—	—	4	—	4	—	—	—	—	20.0	—	20.0
Cornish	—	—	—	—	1	—	1	—	—	—	—	9.0	—	9.0
Davidson	—	1	—	5	—	—	6	—	5.0	—	7.5	—	—	12.5
Deane	8	1	—	17	—	1	27	10.0	1.4	—	27.1	—	1.0	39.5
Holly-Gask'll	5	—	—	5	—	—	10	8.0	—	—	9.5	—	—	17.5
Knowles	—	1	1	11	2	—	15	—	0.1	0.4	15.0	4.0	—	19.5
Lang	—	3	1	—	—	—	4	—	5.5	1.0	—	—	—	6.5
Leavitt	—	—	—	2	—	—	2	—	—	—	10.0	—	—	10.0
McAlpine	—	—	—	1	—	—	1	—	—	—	6.0	—	—	6.0
Morris	—	—	—	2	—	—	2	—	—	—	10.0	—	—	10.0
Nagle	—	—	—	—	1	—	1	—	—	—	—	5.0	—	5.0
Russell	—	—	—	2	—	—	2	—	—	—	4.0	—	—	4.0
Wood	1	1	—	—	—	1	3	2.0	6.0	—	—	—	1.5	9.5
Worthington	8	3	2	40	5	4	62	6.6	5.0	1.5	98.7	9.0	5.0	123.8
Miscell'neous	3	1	3	8	3	3	21	1.0	—	3.4	3.9	4.1	15.5	27.9
Total	29	12	7	109	16	9	182	32.8	24.0	6.3	204.9	51.1	23.0	342.1
No. of different works with pumps	18	8	6	73	8	9	122	Three pumping works of trifling capacity are omitted, making 125 in all, against 130 gravity works.						

The miscellaneous class includes unknown also, the most important item in which is 2 pumps of 15,000,000 galls. capacity at New Haven, driven by water.

TABLE 17.

NEW ENGLAND WATER-WORKS.—RELATIVE RESERVOIR CAPACITY AND CONSUMPTION OF 66 WORKS.

(Including the more important or significant works only.)

Water-works.	Storage capacity.	Daily consumption.	Days supply stored.	Water-works.	Storage capacity.	Daily consumption.	Days supply stored.
	Millions of gallons.				Millions of gallons.		
MAINE				Greenfield	10.0	0.4	25.
Augusta	13.6	0.4	32.5	Hyde Park	1.5	0.1	15.
Biddeford	10.0	0.78	12.9	Lawrence	40.0	2.5	16.
Brunswick	7.0	0.1	70.	Lenox	0.7	0.45	15.5
Dover	3.0	0.02	150.	Lowell	30.0	4.32	7.
Gardiner	2.0	0.2	10.	Lynn	20.0	2.38	8.4
Lewiston	5.0	1.6	3.1	Nantucket	3.5	0.265	13.2
Portland	30.0	5.0	6.	New Bedford	400.0	3.047	131.
NEW HAMPSHIRE				Newton	15.	0.204	73.5
Claremont	29.0	0.15	193.	N. Adams	11.8	1.0	11.8
Great Falls	1.5	0.3	5.	Northampton	20.5	0.15	137.
Laconia	2.75	0.34	8.1	Pittsfield	0.6	0.2	3.
Nashua	4.0	1.5	2.7	Plymouth	3.0	0.59	5.1
Pittsfield	1.5	0.2	7.5	Revere	1.5	0.35	4.3
				Salem	20.0	2.58	7.8
VERMONT				Springfield	230.6	4.00	57.7
Brattleboro	7.5	0.05	150.	Waltham	6.	0.6	10.
Burlington	2.4	0.017	141.	Westfield	184.	1.0	184.
Montpelier	4.25	0.9	4.5	Winchester	260.	0.25	1040.
St. Albans	100.0	0.5	200.	Woburn	8.	0.87	9.2
Winooski	5.0	0.16	31.2	Worcester	1200.	4.0	300.
				RHODE ISLAND			
MASSACHUSETTS				Newport	10.	1.0	10.
Adams	10.0	0.8	12.5	Pawtucket	21.	3.18	6.6
Amesbury	5.0	0.1	50.	Providence	125.	4.92	25.4
Beverly	3.2	1.0	3.2				
Boston	2827.2	29.85	95.	CONNECTICUT			
" (Mystic)	41.2	7.63	5.4	Ansonia	10.	0.275	36.3
Brockton	330.0	1.	330.	Hartford	1270.	5.0	254.
Brookline	6.0	0.77	7.8	Meriden	300.	1.3	231.
Cambridge	5.4	3.86	1.4	New Haven	17.	8.8	1.9
Chicopee	5.2	0.03	173.	Norwalk	4.5	0.7	6.4
Clinton	20.0	0.4	50.	Southington	64.	0.7	91.5
Dalton	3.2	0.027	118.	Stamford	7.0	1.0	7.
Danvers	5.5	0.45	12.2	Torrington	71.0	1.0	71.0
Fitchburg	289.0	1.183	236.	Waterbury	9.0	1.5	9.
Gardner	3.0	0.2	15.	Willimantic	5.0	0.35	14.3
Gloucester	10.0	0.4	25.				

PUMPS.

Table 16 shows fully the practice of the New England States in regard to pumps. The largest single pumping works by far is at Providence, R. I., where 5 engines have a combined pumping capacity of 33,000,000 galls. Nearly all of the larger works in this section are by gravity, but there are several very large pumping works, although most of them are small. The aggregate pumping capacity of all the pumps in New England is only 342,100,000 galls., or less than the capacity of the new Croton Aqueduct alone, and it is to be remembered also, that on an average rather less than one-third of this capacity is in actual use.

The comparison by makers will be interesting to every engineer, and shows a great variety in use, with the Worthington far ahead of any single maker. It is to be remembered however, that this covers only a very small corner of the Union, and perhaps one-sixth of its water-works. Some of the pumps make a much better relative showing in other sections. Considerably more than two-thirds of the total capacity is monopolized by six makes of pumps, the Worthington, Deane, Blake, Corliss, Knowles and Holly-Gaskill. The Davidson and Woods pumps come next, with about 10,000,000 capacity each, and 15 different makes in all are represented, not counting those with one pump, each included in miscellaneous.

RESERVOIR CAPACITY.

It is somewhat difficult to effectively summarize reservoir capacity, since the natural requirements of different works vary greatly, and also the difficulty of obtaining a stored supply. Some small towns drawing from large lakes have several years' supply by natural storage. Others with supply pumped from abundant sources of natural supply and with duplicate pumps to insure against breakdowns, need and properly have but a very limited supply. Others again have urgent need of a large stored supply from lack of these advantages, and in many cases have been able to obtain it very easily by cheap dams.

Table 17 gives the facts in regard to reservoir and daily consumption for 66 waterworks, including most of the more important. The last column is the most significant, giving the days supply stored, which ranges from 1,040 days in the case of Winchester, Mass., to 1.4 days supply at Cambridge, Mass., but here there are 4 pumps with a combined capacity of 5,000,000 galls. against a consumption of less than 4,000,000, and back of the pumps is a reservoir of 360,000,000 galls. containing over 90 days' supply, so that the mere "face of the returns" is not a fair criterion. The total storage capacity of a few of the cities is:

Boston, Mass., Main system	95 days.
" " Mystic "	54 "
Providence, R. I	25 "
Newport, "	10 "
Hartford, N. H	254 "
New Haven, Conn. (large supply back of pumps)	2 "
Worcester, Mass	300 "
Springfield, "	58 "
New Bedford, Mass	131 "
Fitchburg, Mass	236 "
Portland, Me	6 "

DAMS.

The highest and most important masonry dam (for water-works only) in New England is at New Haven, Conn., 500 ft. long by 38½ ft. high, 3 to 6 ft. thick on top and 27½ ft. at the bottom. The dam is of interest as having been successfully built on a very thin hardpan stratum overlying quicksand by reinforcing it with concrete and sheet piling. At Norwalk, Conn., there is a short dam 230 ft. long and 32 ft. high, and at Greenfield, Mass., a still shorter one, 60 ft. long by 35 ft. high. At Portland, Me., there is a considerable dam of unreported dimensions, costing $50,000. Otherwise than this there is no dam reported from New England over 150 ft. long nor over 12 to 19 ft. high, and there are only some 24 reported in all.

But one failure of a stone dam is reported, the first Cochituate dam for Boston, the failure being due to insufficient precautions against quicksand. It has been successfully renewed by careful sheet piling.

Practically all the New England waterworks dams of any size are of earth, usually with a thin rubble masonry heart wall, a few only trusting to puddle walls. The most considerable water-works dam failure which ever occurred in New England, that at Hartford, Conn., appears to have been largely due to the use of a puddle instead of rubble heart wall. An excessive flood destroyed a partly built dam above and the rise of water soon cut away the dam down to the puddle, and in a few hours cut away the puddle as well, as narrated in full in the account of the Hartford waterworks; but the dam was renewed with a puddle heart, and has stood well. Other earth dam failures have been at New Bedford, Mass., due to quicksand underlying a thin stratum of hard pan, and especially at Worcester, Mass., (Lynde Brook) where the waste gate became choked, and the dam failed by the gradual enlargement of old leaks, due to defective original construction, and especially an increase of height from 29 to 44 ft.

We have details of 63 earth dams of which the following are the more notable structures.

Cambridge, Mass, 1,100 ft. long by 85 ft. high, rubble heart wall.
Hartford, Conn., 728 ft. long by 53 ft. high, puddle heart.
" " " 570 " " " 42⅝ " " "
(4 dams of about this size)
Springfield, Mass., 1,297 ft. long by 48 ft. high, rubble heart wall.
Fitchburg, Mass., 1,397 ft. long by 46 to 63 ft. high, rubble heart wall.
Fitchburg, Mass., 400 ft. long by 42 ft. high, rubble heart wall.
Newport, R. I., 2,800 ft. long by 15 ft. high, (sand).

Fully 50 of these dams use a carefully laid rubble masonry heart wall, of course in cement. The remainder use puddle walls.

We have reports of only two timber dams in New England, one at Bangor, Me., and one at St. Johnsbury, Vt., both insignificant structures, although that at Bangor is 900 ft. long.

TUNNELS.

The water-works tunnels in New England are few. We have reports of one at Bridgeport, Conn., 2,700 ft. long, one at Lowell, Mass., 733 ft., one at Fairhaven, Vt., 150 ft. long, and several on the Boston water-works of considerable length, the aggregate of which is not reported.

NEW PROJECTS.

We have details of the following works as projected with fair prospect of early construction.

Maine	11
New Hampshire	2
Vermont	0
Massachusetts	5
Rhode Island	4
Connecticut	3
Total New England	25

This will be an addition of about 9 per cent. to the existing water-works; and while some are likely to fall through, a large proportion of them are likely to be completed during the year 1889.

A British Criticism of American Railway Management.

The English financial and railway papers bring us full and rather interesting accounts of the meeting held by the English stockholders of the Chicago, Milwaukee & St. Paul Railroad Company in London, after the news was received that the dividend had been passed. The chairman of the meeting, Mr. JOSEPH PRICE, gave an account of his investigation into the affairs of the company, in which he complained of the ignorance in which the stockholders were kept of the real status of the company's finances; but the only matter in which he seems to have been able to discover any definite indication of what appeared to him to be mismanagement, was the item in the annual report regarding the amount of stores which the company had on hand. Of this he said:

"The marvelous thing to me is that on December 31, 1887, they had no less than $3,000,000 worth of stores on hand. That does not look as if they were trying to keep themselves financially strong; and a further examination of what these stores consist of, as shown in the figures of the report brings out this result: that on December 31, 1887, they had no less than 1,620,000 ties—what we call sleepers. That is enough to build 650 miles of railway at 2,500 ties to the mile. They also had 32,300 tons of rails. Now, in the depth of winter what possible necessity could there be for such an enormous stock as that? Well, you would naturally say, "Perhaps they are engaged in very large construction work", so we look through the report to see if that is the case; but you find on page 11, where they refer to the fact that they have added 371 miles of railway during the year, this paragraph: "With the completion of the foregoing lines, all new construction was practically finished at the close of the year, and no new work has since been authorized or undertaken by the company." Now, they had $1,500,000 more stores than at the end of 1885, and $1,000,000 more stores than in 1886. * * * * *. As I said before with regard to the stores account, I think it is a most important thing to bear that in mind as enabling you to form a judgment as to what has been the cause of all this trouble, and why they are poor."

Was this an excessive amount of stores to have on hand? Mr. PRICE evidently thinks so, and his judgment seems to have been regarded as sound. The *Railway Press* says editorially:

"There has been a large and unnecessary purchasing of stores to the amount of three millions of dollars, sufficient to construct 600 or 700 miles of road; and the balance usually available for dividend has been absorbed or diminished as much from this cause as from any cutting of freights."

But before we acknowledge that the managers of this system have wilfully locked up their surplus earnings in this way, merely to "bear" the stock market, as is hinted; or even that they have been unwise or negligent in allowing so large a stock of materials to accumulate, let us see what the practice of other companies, similarly situated, is in reference to the amount of stores kept on hand. According to *Poor's Manual*, the following showings were made by the balance sheets of several companies, for materials on hand at the close of their last fiscal year:

Company	Mileage.	Materials on hand.
Chicago, Mil. & St. P.	5,670	$2,927,121
Chicago, Buri. & Quincy	4,693	2,738,500
Chicago & Northw'tern	4,101	3,000,977
St. Paul, Minn. & Man.	1,935	2,040,582
Northern Pacific	3,102	1,425,445

The list might be indefinitely extended; but the above systems taken at random are ample to show that the St. Paul managers have been not even so lavish in the accumulation of stores as have some of their conservative rivals. When we consider the fact that the operating expenses of the St. Paul system for 1887 were $15,326,693, it is plain that the amount of stores on hand was hardly more than an ample provision for the needs of the immediate future.

If the foreign stockholders of American railway securities wish to unite in any movement for dictating the management of their property in this country, that is their privilege. But unless they choose some gentleman with a deeper in sight into the mysteries of railway management than Mr. JOSEPH PRICE seems to possess, their union will not be likely to effect much benefit to themselves or any one else.

PERSONAL.

U. S. LUTZ, Civil Engineer, has removed from 427 Walnut St., Philadelphia, to Holmesburg, 23d Ward, same city.

WM. H. JOYCE has been appointed General Freight Agent of the Pennsylvania Railroad Co., vice JOHN S. WILSON, resigned.

R. M. BOLLING has been appointed City Engineer of Montgomery, Ala., to succeed W. G. WILLIAMSON, resigned.

GEORGE H. SCHULTE, General Agent of the Burlington road in Minneapolis, has resigned to accept a similar position on the "Soo" road.

C. P. HAMMOND, of the engineer corps of the Richmond & Danville R. R., was married recently at Mobile, Ala.

H. B. STONE, General Manager of the Chicago, Burlington & Quincy system, is, according to report, to be Vice President of the company. E. P. RIPLEY, Traffic Manager, will be General Manager.

Major EDSON J. WEEKS, General Agent of the New York Central & Hudson River Railroad, will succeed the late HENRY MONETT as General Passenger Agent of that road.

P. HARRISON, Chief Engineer of the Vicksburg Wharf & Land Co., and of the dummy railway at Vicksburg, Miss., was killed Oct. 12, by being thrown into the river by a land slip at Klines landing.

WILSON BROS. & Co., Civil and Consulting Engineers and Architects, have removed from 435 Chestnut St., to Drexel Building, corner of Chestnut and Fifth Sts., Philadelphia, Pa., where they may hereafter be addressed.

Col. W. H. PAINE, M. Am. Soc. C. E., and well known for his work on the Brooklyn bridge, on cable railways, etc., delivered a lecture this week before ALEXANDER HAMILTON Post No. 182 G. A. R. on "Topographical Engineering in the Army of the Potomac." With his almost unique experience in Virginia, from the beginning to the end of the late war, we know no one better equipped than Col. PAINE, to make such a lecture both interesting and instructive.

JOHN ANDERSON, of the firm of ANDERSON & BARR, has returned from New South Wales after having most successfully completed the difficult foundations of the Hawkesbury bridge. Five spans of this structur are now swung, and the remaining two will probably be completed within the next six weeks. Although the American contractors, with the Union Bridge Company as the principal, took this work at about one-half of the English estimate of its cost, the work has been done in an eminently satisfactory manner, and the Americans have at least not found it necessary "to walk home"; in

other words, they seem to be well satisfied with the result of their enterprise on foreign shores.

WILLIAM H. SOULE, who recently resigned the position of Superintendent of Motive Power of the New York, Lake Erie & Western Railroad, has been appointed Superintendent of the ordnance foundry at the Washington navy-yard. Mr. SOULE is a graduate of the Rensselaer Polytechnic Institute, of Troy, N. Y.

MICHAEL MULRY, a millionaire contractor, who came to this country from Ireland, when a young man, as a laborer, died in New York, Oct. 9, at the age of 70. It is said that the discovery of hidden treasure beneath an old house on Grand St. enabled him to go into business on his own account. He was proprietor of the United States Hotel at Far Rockaway.

PUBLICATIONS RECEIVED.

Gen. A. W. GREELY, Chief Signal Officer, has written for the November *Scribner's* an article entitled "Where Shall we Spend our Winter?" which will be of great value to invalids and pleasure-seekers.

The Fisheries and Fishery Industries of the United States. By GEORGE BROWN GOODE. Section I, Natural History of Useful Aquatic Animals, with an Atlas of 277 plates. Tenth Census, U. S., Washington, D. C. Government Printing Office.

Annual Report of the Board of Regents of the Smithsonian Institution, showing the operations, expenditures and condition of the Institution to July, 1885. Part I. Washington, D. C. Government Printing Office, 1886.

The Theory of the Continuous Girder; its Application to Girders with and without Variable Cross-Sections. By MALVERD A. HOWE, C. E.; Professor of Civil Engineering, Rose Polytechnic Institute. New York. Engineering News Publishing Co., Publishers, 1889. Price $2.00.

In treating of a subject generally novel and more often ignored by American engineers in the light of older materials and practice the author here presents to computers, engineers and students a complete, mathematical treatment of the theory of continuous girders, and shows how this theory can be applied to any girder under any conditions, but especially to fixed girders and girders of two and three spans. Now that iron and steel can be practically made with a constant modulus of elasticity, he starts with the single assumption that it is constant and then deduces a general equation for the moment over any support of any girder under any condition of loading and any length of span, of variable or constant, cross-section and for supports at any level. And from this equation special equations are deduced for special cases. Several examples are solved to show the application of the formulas and to prove that the processes are almost mechanical when the formulas are thoroughly understood.

Map of the Hocking Valley Coal & Iron Region.—Compiled by W. H. JENNINGS, Chief Engineer, Columbus, Hocking Valley & Toledo Railway, Columbus, O., 26×30 ins. Scale: 6,400 ft. = 1 in. Paper $1.00; cloth $2.00; mounted $3.00. This is a lithographed map of the Hocking Valley coal fields in Ohio showing, by contrasting colors the lands which are owned, controlled or operated by the different coal companies together with the railways tapping the field and the connections to which they are tributary.

The Iron Interests of the South, by R. H. EDWARDS. This is a pamphlet of 8 pages reprinted from the *Manufacturer's Record* of Baltimore, devoted to stating the recent development of the interests of the South.

"Straight Tips". Architect's Manual and Builder's Guide. Compiled by T. H. BOORMAN. Published by C.A. Coffin & Rogers, John St., New York. 76 pp. 25 cts.

This handy little book contains the rules, etc., of the American Institute of Architects; a list of members of the New York Chapter of this Institute; a directory of the architects of New York and Brooklyn; a list of the officials of the Architectural League of New York, Building Material Exchange and similar associations; also a city official directory and the text of the Tenement House Act. Alternate pages are devoted to advertisements.

THE Electric Automatic Transit Company has nearly completed its experimental plant at Baltimore. A 2-mile circular track is being erected. The plant will include a 130 horse-power BALL engine and a dynamo from the SPRAGUE works in New York. The purpose is to demonstrate the feasibility of transmitting cars carrying mail matter at "lightning speed" from city to city. The inventor is Mr. DAVID G. WEEMS, of Baltimore, Md.

THE ceiling of the Assembly chamber at Albany, N. Y., is to be completed next month, according to the statement of the contractors. The oak frames for the panels are being put in place.

CORRESPONDENCE.

"Bad Work on the Croton Aqueduct."

TARRYTOWN, Oct. 18, 1888.

EDITOR ENGINEERING NEWS:

Your article on the "Bad Work on the Croton Aqueduct" in the issue of Oct. 13, displays the fact that you have been grossly imposed upon by some one on whom you trusted for reliable information. The real facts of the case are bad enough, and no engineer interested in having public work done honestly, would object to a widespread exposure of the real state of affairs. Contractors, and engineers as well, would be benefited thereby, but misstatements and exaggerations fail in their object. They mislead the judgment in placing the responsibility, and in devising means for averting similar occurrences. Such will no doubt be the effect of your article, and I wish I had time (for this issue of your paper) to point out in detail the many points of error in your account; but, I must confine myself at present, simply to controverting a few of the statements that affected your judgment of the competency and integrity of the engineering force on the division.

You state that there was an unusually large number of engineers employed on this work. This is incorrect, as far as this division is concerned. There never has been a sufficient number of engineers for the work required of them. During the height of the work, when operations in tunneling and various kinds of masonry were going on, simultaneously, day and night, at 67 different working points, in tunnel aggregating 35,000 ft. (nearly twice the length of the Washington Aqueduct) I had in my corps 3 assistant engineers, 2 transitmen, 2 rodmen, 1 chainman and 9 laborers, while 38 inspectors were attending to the masonry.

You say that inspectors were on eight hour shifts. This was never the case until within the last two months while repairs were going on. Inspectors were on 11 hour shifts and were obliged to work in tunnels so viciously ventilated that the strongest constitutions could not endure more than an hour or two of such work without relief.

You state that one of the cavities discovered on this division cubed 300 yards, and must have been closed in in one night. This, again, is not true. A succession of cavities, aggregating something like that figure, was discovered, but they were separated from each other by blind walls, some of which were 6 and 8 ft. in thickness, and built deliberately to deceive the engineer on his daily visit.

I agree with you that the careful record kept by the Division Engineer of the amount of cement used at various places in tunnels would have enabled one to detect the fraud that was being practiced, but these records were sent weekly to the Principal Assistant Engineer, who was charged with the special duty of checking all the quantities of the Division Engineer's estimates and the work shown by the weekly progress reports.

I regret that while visiting the work on this division you did not take the opportunity to call on me for a verification of the many statements made to you. I might also have given you some facts about the good work that we have done here, notably on Section 6, where the work was being conducted by the engineers on exactly the same plans in progress on Sections 4 and 5, but under different contractors. I do not wish to make comparison with other sections, but if you desire to continue that plan, I hope you will make inquiry in regard to this matter. Respectfully yours,

DIVISION ENGINEER, *Division* 2.

[Our correspondent errs in supposing that our opinions were based on information alone. We visited and examined the work personally, and in expressing our views we were guided by what we saw. We accept the correction as to the engineering and inspecting force, especially as the combined staff is even larger than we had supposed, and are willing to make all due allowances for difficult conditions of work and scant inspection. As to the cavity visited, we certainly saw no evidence of any previously existing bridge-walls. But, accepting the statement that walls did exist in this 50 ft. space, unfortunately for our correspondent's position, it is a matter of official record with the Aqueduct Commission that two other cavities *without bridge-walls* and each about 70 ft. long had previously been discovered on this same Division.

The comparatively better work on the 6th Section, which was on another contract, rather makes the case stronger against the engineer; for while he had charge of all the work, the worst parts seem all to be on the contract that has been generally very bad, and the good section belongs to another contractor, whose failings have been much less apparent. We accept the correction as to inspectors and their hours of labor; but the contractors might well claim that an atmosphere that was good enough for their men to work in for 8 hours at a time ought certainly to be good enough for another man who had simply to watch these men at work. The inspectors on much of the work were morally weak, but we did not know that they were constitutionally so as well.—ED. ENG. NEWS].

Keeping Notes of Curves.

Eng. Department, Aqueduct Commissioners.
YONKERS, N. Y., Oct. 15, 1888.

EDITOR ENGINEERING NEWS:

I enclose you a form for keeping transit notes on railroad location which I used about fifteen years ago on the Reading Railroad, and also in Virginia and other States.

This method is quick and easy in the field and will not require about a column of your valuable paper to "explain" it. Yours truly,

S. F. MORRIS. *Div. Engr.*

[This is our correspondent's table at the left of the double line, in which the oldest and poorest of all methods of keeping curve notes is set forth. At the right of the same double line, in the last column, is given the correct form of making up the deflection columns for the same notes, general for any or all T.P.s between P.C. and P.T., or for running the curve in either direction, whereas the first must be cooked and doctored for every change. Let our correspondent try an odd curve with odd pluses, and odd and changed intermediate T.P.s, and he will probably discover the difference, although it seems to require a surgical operation to enable some of our correspondents to do so.—ED. ENG. NEWS.]

Station.	Distance	Deflection	Cal. Co.	Mag. Co.	Deflection
116					
115					
+50 P.T.	1000	7°	N46° 28' E	N46° 30' E	14°
114		6°			13°
113		4°			11°
112		2°			9°
111		7°	N32° 28' E	N32° 30' E	7°
110		5°			5°
109		3°			3°
108		1°			1°
+50 P.C.	700	4° C. to	Rt. for	28°	
107					
106					
105 P.T.	250		N18° 28' E	N18° 30' E	

"LIGHT RAILWAYS" was the subject of a paper read lately before the English Society of Engineers by Mr. WM. LAWFORD. The author proceeded to show why such roads as built by English engineers had not been successful commercially, and among other types of construction he strongly recommended the bogie truck. He contrasted the cost of railway construction in England and America showing that it was as $30,000 is to $200,000 per mile; and concluded that as light railways can be made to pay their promoters in other countries the only reason why they did not do so in England was because they "had not yet had fair play accorded to them.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—The regular meeting was held Oct. 17, Vice President J. J. R. CROES in the chair and a good number of members present. The Nominating Committee has presented the following list of officers for 1889: President, MAX J. BECKER, Pitts-

burg, Pa.; Vice President, A. FTELEY, New York. and E. L. CORTHELL, New York; Treasurer, GEO. S. GREENE, Jr., New York; Secretary, JOHN BOGART, New York; Directors, C. B. BRUSH, Hoboken, N. J., ELIOT C. CLARKE, Boston, Mass., WALTER KATTE, New York, ROBERT E. McMATH, St. Louis; WM. P. SHINN, New York.

The Secretary then read the paper of the evening, on "The Construction of the Sweetwater Dam, San Diego, Cal.," by JAMES D. SCHUYLER, M. Am. Soc. C. E. This is a curved dam 90 ft. high, 12 ft. thick at the top and 46 ft. thick at the bottom, it is built on a compound curve, 222 ft. radius in the center and 117 ft. radius at the sides. This dam was briefly described and illustrated in ENGINEERING NEWS. April 7, 1888, which, by the way, was the date of the completion of the work. The dam is of rough rubble masonry laid in cement mortar; the stone used was exceptionally heavy and the weight of the masonry was 164 lbs. per cu. ft. Horse power was used for hoisting, owing to the cost of fuel and the number of engines that would have been required. The work was designed to take in some foundation work that had previously been started and abandoned, and this modified the design to some extent. It was intended to be 60 ft. high, but shortly before completion it was decided, on recommendation of the engineer, who had made surveys of the basin, to increase the height to 90 ft. thus very largely increasing the storage capacity of the reservoir. This necessitated considerable additional work, but (as was suggested in the discussion) no details were given of the method of uniting the old and new masonry. The total cost, including labor, materials, engineering, etc., was $234,070,11, and the total cost of the masonry complete, was $8.80⅘ per cu. yd. The pipe line from the dam is of riveted iron pipe, by the Risdon Iron Works, of San Francisco; kalamein pipe, by the National Tube Works, of McKeesport, Pa., and spiral welded pipe by Abendroth & Root, of New York; the latter did not stand the transportation and required considerable work to make it watertight after it had been laid. The watershed of the reservoir is 186 sq. miles. The spill way is provided with rows of flash boards, and by removing the rows of boards the water can be let off as required.

Mr. FRANCIS thought it dangerous to have the waste way stopped by boards, and to rely on some individuals to remove them, as a sudden flood would be likely to produce serious results. He calculated that a rainfall of 1 in. on the watershed would raise the level of water in the reservoir 15 ft. He did not favor the curved form.

Mr. BUCK questioned the advisability of building the dam on a compound curve, and thought there would be a tendency to crowd up stream at the point where the two radii meet. It was stated, however, that this was probably done, in this case, owing to the engineer being required to embrace some work already done.

Mr. WEGMANN approved of the curved plan within certain limits; he would limit the radius to that which would produce pressures of about 14 tons per sq. ft., acting as an arch, such radius he thought would be about 500 ft. With too great a radius the dam would not act as an arch. A dam in a narrow valley might well be curved, or it might be built in this form for architectural effect; in any case the arch form can do no harm, but it may require an unnecessary amount of masonry. He thought the dam described approached pretty close to the theoretical minimum, and was of a very bold design.

Mr. FTELEY referred to the very common idea people had that a dam should be of sufficient strength to stand by gravity, but should also be of curved form as an additional safeguard in case of emergency. He instanced experiments for weight made with masonry in cement, stones from small spalls to 3 or 4 cu. ft.; the blocks weighed 155 lbs. per cu. ft.

Mr. CROES referred to the leakage of the Boyd's Corners dam, New York, which has leaked ever since its construction.

Mr. HUNT instanced a dam at New Rochelle, where the water company dispensed with the services of an engineer during construction and when the reservoir was filled the water spouted through the joints of the masonry. He had charge of the repair work which was done from a float, the water being let off as required. In places a stick could be pushed 4 or 5 ft. into the joints. The joints were raked out, then filled and pointed with Rosendale cement (1:1) well tamped in. The dam, which is 25 ft. high, is now tight.

The discussion was also taken part in by Messrs. COOPER, COMSTOCK, etc.

We will give next week a fuller abstract of Mr. SCHUYLER'S paper with the illustrations.

Engineers' Club of Philadelphia.—The first fall meeting was held Oct. 6; President JOSEPH M. WILSON in the chair; 25 members and 2 visitors present.

Mr. FREDERICK STAMM presented a paper on "Chimneys for Horizontal Tubular Boilers." The author discusses the subject of chimney draft under various conditions, and presents formulæ for area of flue and height of stack, with examples.

Mr. H. W. SPANGLER presented a paper on "Leaky Pistons and Indicator Cards." It is generally assumed that the curves of expansion and compression on an indicator card taken from an engine having tight piston and valves and unjacketed cylinder, should be a rectangular hyperbola, having clearance and vacuum lines as asymptotes. If piston and valves leak, the curves should be no longer of this nature, and it is practically impossible that these leaks should neutralize each other at the extreme end of the expansion curve and beginning of compression. If a scant line is drawn cutting an hyperbola, the parts of this line between the curve and the asymptotes should be equal. If, therefore, the curve is an hyperbola, a line drawn cutting the expansion line would cut the vacuum and clearance at equal distances from the curve. As the clearance cannot always be obtained, points can be determined in this way that should fall on the clearance line. If two points are determined from the expansion line, or one from the expansion and one from the compression, these points should be in a line at right angles to the vacuum line. An attempt to apply this to cards from engines known to be tight, and taken by indicators in good order, in many cases has shown that the curves are not hyperbolas. In attempting to work out the equation of the curves, the difficulty of obtaining the clearance, even approximately, has reduced the number of cards available for the work much below that from which one would desire to make any general deductions. The results here given are taken from various makes of engines, making from 60 to 200 revolutions, developing from 30 to 250 indicated horse power, and these are given that they may interest others in the matter, and either tend to prove or disprove the generally accepted idea. Assuming that the equation of the curve is in the form $p\ r^n$ = constant, and the valves of n have been generally between 1.15 and 1.35 or 9-8 and 4-3. It is to be noted that Grashof gives 1.15 for the value for compression curves and 1.33 for expansion curves when the steam is dry after expansion.

Mr. FRANK COOPER read a paper upon the "Economics of Momentum Grades, with Especial Reference to Tributary and Suburban Railways." The object of this paper is to outline a method by which an approximate idea may be formed of the relative effects produced by a succession of sags 25.6 ft. deep, in comparison with a dead-level line of railway, taking various speeds of trains, with stops located from 1 to 10 miles apart. Having determined under fair conditions the energy thus saved, and knowing the average percentage of cost of fuel per train-mile to operating expenses, and to net earnings according to the census of 1880, then applying the percentage of energy saved to this cost of fuel, an estimate may be formed of the value of the principle. There are three grades in the vicinity of Philadelphia where this action may be studied; between Germantown Junction and North Penn Junction, N. Y. Div., P. R. R.; on the Bound Brook R. R., just beyond Jenkintown, from Noble to Somerton; and on the Germantown & Ch. Hill Br., P. R. R. From the moment of starting at Westmoreland until that of stopping at Queen Lane on this last grade, a distance of 1.5 mile, not infrequently an average speed is obtained of 35 to 37 miles per hour, with three and four passenger cars on the ordinary accommodation trains. On the Bound Brook sag, six miles were recently made in 5 min. 32 sec., from summit to summit; a mile, at the foot, in 50 sec.

The Secretary presented, for Mr. ROBT. A. CUMMINGS, a "Table of Square Feet in Decimals of an Acre", for the Reference Book.

HOWARD MURPHY, *Secretary and Treasurer.*

New York Railroad Club.—A business and social meeting of this Club was held Oct. 11, at the rooms 113 Liberty St. Arrangements for regular monthly meetings during the coming season were made. The next meeting will be held on the third Thursday in November.

The subject of freight train brakes will be discussed, and papers are to be presented by JAS. HOWARD of the Beals Brake Company, Mr. SLADE of the Eames Vacuum Brake Company and Mr. GEO. WESTINGHOUSE.

American Institute of Electrical Engineers.—The twenty-eighth meeting of the Institute, and the first of the present season, was held at the House of the American Society of Civil Engineers, 127 East 23rd St., Oct. 9.

The programme of the evening was the discussion of Mr. FRANK J. SPRAGUE'S paper on "The Solution of the Municipal Rapid Transit Problem", which was read at the the last special meeting, June 19. Messrs. M. B. LEONARD, of Richmond, GEORGE W. MANSFIELD, of Boston, ROBERT W. BLACKWELL, of New York and others discussing the paper, which contained much new and valuable matter.

RALPH W. POPE, *Secretary.*

Technischer Verein (German Technical Society) of New York.—At the annual meeting of the Society, held Oct. 13, the following officers were elected: President, G. W. WUNDRAM, M. E.; Vice President, E. A. GIESELER, C. E.; Corresponding Secretary, H. W. FABIAN, Architect; Recording Secretary, H. BERG, M. E.; Librarian, F. KNAUER, C. E.; Trustees, A. KURTH, C. E.; P. GÖPEL, C. E.; O. PULLER, M. E.; A. DORFLINGER, C. E.; E. L. HEUSNER, M. E.; A. V. D. DRIESCH, Architect; TH. BREYER, Chemist. The number of members at present is as follows: civil engineers, 49; mechanical engineers, 111; architects, 36; chemists, 37; total, 233.

H. W. FABIAN, *Corr. Secy.*

[From our own correspondent.]

American Institute of Mining Engineers.—Fifty-second meeting, held at Buffalo, N. Y., Oct. 2, to Oct. 6, 1888.

When Buffalo undertakes to entertain, she follows the advice of Pooh Bah to the Lord High Executioner and does it well. Those of us, who had enjoyed the entertainment given to the Civil Engineers some years ago, remembered what unbounded hospitality was bestowed upon that Society, and how each member felt as though he had many personal friends among his new acquaintances in Buffalo. The Institute therefore assembled with glowing anticipations of a good time, and as a matter of course, they had it.

We cannot say that Buffalo had absolutely built a new hotel in anticipation of our visit, but it is a little singular that the Genesee House was opened just about the time of the Civil Engineers' meeting, and on the present occasion the Niagara House was just under way. If Buffalo intends to offer each scientific body convening there a new hotel, she is far ahead of all other cities in the U. S., and it may be noted that another large and finely appointed house is under construction, perhaps in anticipation of the visit of some other distinguished body.

We were rather startled when we received the elegant programme of the meeting to see that the Local Committee numbered 72, and feared, that is some did, that if their healths should be all drunken, some of the participants might be in the same condition, but inquiry developed, as is usually the case, that less than one-tenth of this number had really done any work, so the Prohibitionist in the Institute (He was absent, by the way) was assured and the temperance men were not frightened. The visitors assembled Tuesday evening in the elegant rooms of the Society of Natural Science in the new and beautiful Buffalo Library Building, which is certainly a structure of which Buffalonians have a right to be proud. It was, here, that we received a most cordial welcome by Dr. JULIUS POHLMAN of Buffalo, in which he gave us the gratifying information that we would not be asked to purchase town lots in Buffalo. It may be remarked that the appearance of the Institute was quite respectable and fairly well-to-do, but probably Dr. POHLMAN has been an engineer, and knows their general average bank account.

President POTTER responded suitably to this welcome, and then delivered his annual address, which was on the needs of the Mining Engineers. It was not at all sarcastic, although, following Dr. POHLMAN'S statement it might have seemed so, but these were defined to be, technical education and laboratory and practical tests of a reliable character, accessible to the engineer. He advised the construction of public engineering laboratories with full sized machinery for trying timbers and for testing ores. It might be said, the Boston Institute of Technology is working in just this direction, and as a result of some of their "full sized" tests, some "full sized" theories have shrunk a little. He cited the St. Louis Sampling & Testing Works as an instance of this desired advance and their results had been used by his students at the Washington University with advantage. The address was enjoyable, and commanded the careful attention its subject and the speaker's treatment of it deserved.

Dr. RAYMOND described "a gold breastplate from Central America" which he thought was 400 years old.

The next day the party went to Dunkirk and were shown through the Brooks Locomotive Works, which proved extremely interesting. This was followed by a fine entertainment at the Brooks mansion. Just before its conclusion, several of the members slipped out and went with the Rev. Mr. MARTIN to see his Car Heater Factory. This gentleman was a Presbyterian minister of the orthodox school, and believed in heat for the present and future. Thus far he has only applied his ideas to heating passengers in transit, and his plan has proved very successful. Perhaps in his zeal he may have overdone it, at least those who went to Lockport later took this view of it. The Martin heater became almost a "roaster" and the party were "well done", when they preferred to remain "rare". The technical school at the Brooks Locomotive Works attracted much attention and favorable comment. This is the true American idea; our mechanics should be not only skillful but intelligent they must know why they do a certain thing as well as how to do it. All apprentices in the Brooks Works *must* attend this school three nights each week. The President of the company Mr. ED. NICHOLS, was untiring in his efforts to explain the various processes, and equally untiring in his attention to the party in general. That evening, the "Uses of Asphalt" formed a subject for discussion, the paper on this subject being read by Capt. F. V. GREENE, of the Barber Paving Co. The "Life History of Niagara Falls", by Prof. POHLMAN followed. He stated that the Horseshoe Fall was receding about 9 ft. per year, and took the view that eventually there would be rapids and no fall.

Dr. RAYMOND then read a paper on "Soaping Geysers". He found throwing soap into their mouths made them spout, this would be the effect on men, and why not on a geyser? We believe even Dr. RAYMOND would be so affected. He failed to state what the effect would be of

"soaping" the guides in the Yellowstone, no doubt they would spout also.

The next day it rained, and the excursions projected around the harbor could not be comfortably made, although, singularly enough, a full account of these excursions appeared in a Buffalo paper the next morning, together with a statement that they were largely attended and proved extremely interesting (!) thus showing anew the enterprise of the American reporter.

That afternoon, a large party went to the pumping station of the water-works and saw the new Gaskill engine in progress of erection, and from there we went to the Cement Works and saw the "demnition grind", viz., the Carr disintegrator. At this place natural gas has been struck in limited quantities and is used under the boilers and for lighting, but it is not yet of sufficient amount to supply any large area, although they are still prospecting for it.

The party returned in carriages over some miles of the Barber pavement, and thus had a practical example of its smoothness and adaptability to pleasure drives. The works were next visited and a section of the pavement laid before the visitors.

The subscription dinner followed that evening, and papers were read the next morning to some somnolent individuals in consequence. Friday P. M., the party went to Lockport and visited the seven locks, the Holly Manufactory, and the Cowles Electric Smelting Works. The road to the latter was over so rough a road that we longed for the Barber pavement, in fact the road was bad enough to have been "paved with good intentions", well! We reached the Cowles works and saw the largest dynamo in the world, also saw the process of electric smelting, which has been described pretty thoroughly in ENGINEERING NEWS, and seemed to give very satisfactory results.

After this several of the party went to see the operations of the "Indurated Wood Fibre Co." This concern makes all sorts of household utensils from wood pulp, such as tubs, pans, pails, cuspidors and everything to which fire is not directly applied. The results were marvelous, and among other things we were shown insulators which they are making for the Brush Electric Light Co. and which will undoubtedly prove almost indestructible. At all events their use will curtail the field of operation of the small boy, who thinks glass insulators are put up for the purpose of developing his skill in throwing stones. It was stated that this company is making tubes for underground conduits for wires, the material not only being non-conductive but capable of being bent to any desired curve, and it was asserted it would stand a pressure of 300 lbs. per sq. in.

One of our party said he would rather own that process, the "wood pulp" one, than a mine, and it may be said he already owned a mine, but the owner of the process did not offer to trade.

The Lockport cider-mill was next visited. It is said to be the largest source of supply for *French* Champagne in the world, and exports thousand of gallons to the sunny fields of France, from whence, after being "doctored" it returns to its native land and distills headache among those who are unfailing and unerring judges of "good" Champagne, and think our native article: "A beastly mess of slops, don't-cher-know."

A few more papers that evening and "a few more folding of the hands to sleep", and the party rose the next morning and started for the Salt Mine at Piffards, operated by the Retsof Company. The rain was falling, but the spirits of the Institute were but slightly dampened. A short ride brought them to Piffards, where there is a shaft 1,100 ft. deep. The party were lowered into this, and saw two beds of rock salt, one of 20 ft. and one of 60 ft. in thickness. This was stated to be the only rock salt mines in the United States, and its product was certainly very fine. Most, if not all, the American salt comes from salt wells, the brine being pumped to the surface and run into evaporating pans. It was stated that one company quite near the salt wells, prefers to send a long distance to this Retsof mine, and uses 50 tons daily, finding it much more salty and better adapted to their use.

This completed the programme of the Mining Institute. We had all enjoyed Buffalo hospitality to its fullest extent, and felt proportionately grateful to kind entertainers from whom we now reluctantly parted. The Buffalo girls, who are celebrated in song as dancing by the light of the moon, had not "materialized" to any extent, but this was probably because there was no moon to dance by, but we were permitted to see considerable of the Dunkirk young ladies during our visit to the Brooks Locomotive Works, and were so well pleased that it was difficult to get some of the members (and they were not the *youngest* either) to leave on the special train. We had almost to use force, but for some reason, probably the weather, as it was very rainy, we were not favored by many of the Buffalo ladies, this was the only drawback to a thoroughly enjoyable visit. We could not shake off the *dust* of our feet because the dust had become *mud*, so we wrung the moist hands of our entertainers, and parted to meet in New York City this winter.

The American Society of Mechanical Engineers began their 9th annual meeting at Scranton, Pa., on Oct., 16. About 200 delegates were present. They were welcomed to the city by Colonel J. A. PRICE of the Board of Trade, and a response was made by Vice-President WOODBURY, in the absence of President HORACE LEE. Several papers were also submitted, notably "The Distribution of "Internal Friction" and "The Variable Load, Internal Friction and Engine Speed" by Dr. R. H. THURSTON, of Cornell University, and by Professor DENTON, of Hoboken, on "The Friction of Piston Packing Rings in Steam Cylinders."

The report of the finance committee, and the library committee were read, after which the result of the election of officers for the ensuing year was announced as follows: President, H. R. TOWNE, of Stamford, Conn.; Vice-Presidents, WILLIAM KENT, of New York; T. J. BORDEN, of Fall River; B. RICHARDS, of New Haven; Managers, WILLIAM FORSYTHE, of Aurora, Ill.; FRANK H. BALL, of Erie; GEORGE M. BOND, of Hartford, Conn.; Treasurer, WILLIAM H. WILEY, New York. Other essays were read and discussed as follows: "The Use of the Compound Engine for Manufacturing Purposes", by CHARLES T. MAIN; "The Flow of Steam in a Tube", and A Simple Calorimeter", by CECIL H. PEABODY, assistant professor of mechanics in the Massachusetts School of Technology. The delegates went through the works of the Lackawanna Iron & Coal Company, and a reception was tendered them at the Young Men's Christian Association Hall.

CONSTRUCTION NEWS.

RAILROADS.

East of Chicago.

Existing Roads.

Central Railroad of New Jersey.—Surveys are reported in progress for a railroad to be built from Winslow Junction on the New Jersey Southern, south to Cape May, about 35 miles. The principal business of the road would be in carrying summer travel.

Battle Creek & Bay City.—Grading on this Michigan road is making good progress. W. L. BRIGDEN of Battle Creek is Chief Engineer.

Saratoga, Mt. McGregor & Lake George.—This narrow gauge road, 10 miles in length, near Saratoga, N. Y., which was placed in a receiver's hands last March, has been bought by W. J. ARKELL of Canajoharie, N. Y., who will reorganize the company.

Port Jervis, Monticello & New York.—This company has gained a second victory in its litigation with the New York, Lake Erie & Western. The latter company ordered its station agents to refuse to receive freight consigned to points on the Port Jervis road. The Court ruled that in its capacity as a common carrier the company was bound to receive the freight.

Philadelphia & Reading.—The directors of the Philadelphia Commercial Exchange at a meeting on Oct. 15, declared it to be their opinion that the Reading Terminal road ought to be built to its proposed terminus at Twelfth and Market streets. President H. K. HINCHMAN was authorized to appoint a committee of three to confer with President CORBIN and aid the Board of Trade in its efforts to promote rapid transit.

Indianapolis Union.—Proposals will soon be asked for about $90,000 worth of masonry and iron girder construction, on extensions of this company's tracks east of the Indianapolis union depot.

Cleveland & Marietta.—The tunnel between Guernsey and Kimbolton, on this Ohio road, is finished and open to traffic. By this new route the heavy grades by which the road crossed the summit are avoided. The Chief Engineer of the Company is C. L. GOULD.

Pennsylvania.—The Cambria & Clearfield Railroad, the St. Lu branch, the King's Run branch and the Brubaker branch, a total of 17.3 miles of road, have been opened for traffic.

Wheeling & Lake Erie.—A large force are at work on the foundations for the bridge across the Ohio river at Wheeling, W. Va., noted on last week's "Engineering News" page. Work is to begin soon on the five tunnels between Bowerston, O., and Wheeling.

Delaware & Hudson Canal Co.—It is stated that changes and improvements are being planned for the Rutland Railroad in Vermont, to be made when this company takes possession of the line. A new line will be built from Chester to the Connecticut river and thence to a junction with the main line about 4 miles above Bellows Falls, and the old route will be discontinued. A branch will also be built from West Rutland to near Clarendon Springs. This would make about 12 miles of new construction.

Concord.—Surveys are in progress for an extension of the Suncook Valley Railroad from its present terminus at Pittsfield, N. H., to Alton Bay, about 15 miles.

Canadian Pacific.—The company has requested the Maine State Railroad Commission to inspect the road now completed from the State line to Greenville, and issue an order permitting its use for regular traffic.—The company has purchased a tract of land at Brownville, at the junction with the Bangor & Katahdin Iron Works railroad, on which there will be erected a round house, repair shop, storehouses, etc.—The Minister of Railways has granted the application for an order authorizing the expropriation of certain lots on the water front of the city of Toronto. It is proposed to erect a union station and system of terminals in Toronto, to be used by the Canadian Pacific and Grand Trunk roads. The grade crossings on the lines entering the city will be removed.

Tilton & Belmont.—The contract for building this New Hampshire road has been let to D. M. HAZLETON, of Concord, N. H., O. M. GALLUP, of Swanton, Vt., and S. S. ORDWAY, of Woburn, Mass. The road is to be about 6 miles in length. C. O. FOSS, of the Concord Railroad, is Chief Engineer.

Maine Central.—Proposals are to be called for at once for the extension of the Dexter & Newport Railroad from Dexter to Dover. The line will be leased by the Maine Central on completion, but is to be built by a separate company. FRANK W. HILL of Exeter is interested. The line which has been located is 18 miles in length, and the estimate of cost is $15,020 per mile. Work is making good progress on the building for the new general offices near the Union station at Portland. The building will be 120 x 57 ft. and two stories high. Winslow & Wetherell of Boston, are the architects and M. C. Foster & Son of Waterville, Me., the contractors.

New York & New England.—The celebration of the completion of the extension of the New Haven & Derby Railroad from Derby to Hawleyville, Ct., was held on Oct. 17. The spike driven was of copper, plated with gold, taken from the U. S. gunboat *Colorado*, recently broken up.

New Projects and Surveys.

Port Chester, White Plains & Tarrytown.—This company proposes to build an electric railroad from Elmsford, N. Y., on the New York & Northern railroad, to White Plains, on the New York & Harlem railroad, and thence to Port Chester and Rye. It has been voted to issue $125,000 in bonds to raise funds for the construction of the road. The offices of the company are at 18 Cortlandt Street, New York City, JAS. E. MILLER is President.

Georgetown, Barge, Dock, Elevator & Railway Company.—This Company will soon commence its work, which will connect with the Baltimore and Ohio Railroad from Shepherd's and with the Baltimore and Potomac Railroad from the Long bridge, and will, it is said, operate also in connection with the new Georgetown and Tennallytown Railroad Company.—Baltimore *Sun*.

Vincennes, Oakland City & Owensboro.—This company has voted to build their line *via* De Gonia Springs, Ind., instead of Boonville, the latter town having twice voted against granting aid to the company.

SOUTHERN

Existing Roads.

Carolina, Knoxville & Western.—The Georgia Construction Co. has been sued by the assignee of Brown & Fortune, the contractors who were building the Tennessee section of this road, for $16,882 the amounts due for grading done since last June. It is stated, however, that the company's finances are all right, and that the matter will soon be settled.

Ohio Valley.—The locating surveys are in progress for the ten mile extension from Henderson, Ky. to Evansville, Ind., and the contract for the grading has been let to the Central Construction Co. of Henderson. The transfer across the Ohio river will be made near Evansville.

Covington & Macon.—Trains on this Georgia road are running nearly to the city of Athens, and work is being pushed as rapidly as possible, as the contractors forfeit $100 per day until the trains are run across the Oconee River bridge.

Carolina, Cumberland & Chicago.—It is rumored that the section just completed between Aiken and Edgefield, S. C., is to be leased by the South Carolina Railroad Company.

Richmond & Danville.—The contract for grading the branch from Winston to Mocksville, N. C., 20 miles, has been let to the State penitentiary authorities.

Alabama Midland.—It is now definitely announced that this company has purchased the Northwest & Florida railroad, and that H. B. PLANT is heavily interested in the enterprise. A construction company has been formed and is obtaining subscriptions to its stock at Montgomery, Ala.

Charleston, Cincinnati & Chicago.—A conference of the principal officers of this system and the officers of the Georgia, Carolina & Northern road was held recently at Columbia, S. C., and the cities of Wilmington and Charleston are deeply interested in the results, as it is rumored that the business of the Charleston, Cincinnati & Chicago is to be diverted as far as possible over the Georgia Carolina & Northern to Wilmington, instead of going to Charleston, as has been expected. In the press reports of the matter it was stated that the Charleston, Cincinnati & Chicago company had 500 miles of road completed and in operation, a statement which will doubtless surprise those who are now at work on this line.

Kentucky Midland.—The reported sale of this Kentucky road to a Philadelphia syndicate is authoritatively denied. Negotiations have been in progress with a Louisville firm known as the Kentucky Construction Com-

pany, of which E. F. MADDEN is President, for letting a contract for building the whole road from Frankfort east 140 miles, including the 40 mile division between Frankfort and Paris on which Mason & Foard are now grading. The negotiations, however, have fallen through and the company remains under control of its original promoters.

East Tennessee, Virginia & Georgia.—The lease of this system to the Richmond, & Danville was ratified by the directors on Oct. 17.

New Projects and Surveys.

Cartersville & Gainesville.—This projected Georgia road is to run from Cartersville, at the junction of the Western & Atlantic and the East & West Alabama railroads, to Gainesville, on the Richmond & Danville and Gainesville, Jefferson & Southern railroads, a distance of about 60 miles. The line crosses the Marietta & North Georgia at Ball Ground, and opens up a region rich in marble, coal, iron, manganese, limestone and timber, as well as some good agricultural lands. The company to build the road has been organized, and has issued stock to the amount of $10,000 per mile, and bonds to the amount of $20,000 per mile. The general offices of the company are at Cartersville. The directors are W. H. HOWARD, M. A. HARDIN, W. J. HEYWARD, GEO. H. WARRING, L. S. MUMFORD, W. C. BAKER and JOHN J. CALHOUN.

Indian Springs.—A narrow gauge railroad is under survey from Flovilla, Butts Co., Ga., on the East Tenn., Va., & Ga. R. R., to Indian Springs. Dewittee & Harrison of Atlanta, Ga., are the engineers.

Monongahela River.—This company has filed its charter in West Virginia and proposes to build a railroad from Clarksburg to Fairmont, about 15 miles, with necessary branches. The incorporators are J. N. CAMDEN, B. D. SPILMAN and V. B. ARCHER of Parkersburg, W. Va., and E. W. CLARK and S. W. COLTON of Philadelphia, Pa. The principal office of the company is to be at Fairmont. The same parties have incorporated the Upper Monongahela Coal & Coke Company and are said to control about 20,000 acres of mineral lands along the line of their proposed road.

Waynesboro, Pascagoula & Gulf Coast.—It is stated that surveys are in progress on this proposed Mississippi road. J. R. S. PITTS of Scranton, Miss., is President of the company.

THE NORTHWEST.

Existing Roads.

Illinois Central.—The belt line of this company at Waterloo, Ia., is graded ready for the rails. The line is about 3 miles in length.

Duluth, Red Wing & Southern. — Amended articles of incorporation have just been filed by which the capital stock of the company is increased to $15,000,000. Contractor SPAFFORD has the bridges between Red Wing and Zumbrota nearly finished.

Northern Pacific. — Through trains began running over the Red River Valley road on Oct. 18.— It is announced that through trains will soon be running to Chicago over the Wisconsin Central. The Wisconsin Central will also join this company in creating a union depot at Ashland, Wis.

St. Paul, Minneapolis & Manitoba. — This company will begin a daily train service over its Montana line on Nov. 10. Each train will be fitted up with dining and sleeping cars.

Winona & Southwestern. — The Winona construction company, which is building this road, has been reorganized and is now composed of the following members: M. G. NORTON, WM. MCINTYRE, H. W. LAMBERTON, R. D. CONE, E. S. YOUMANS, CHAS. HORTON, V. SIMPSON, ANDREW HAMILTON and JOHN ROBSON. The company intends to complete the 20 miles under contract this season and push construction along the whole line next year.

Eastern Ry. of Minnesota.—It is announced that this company has let the contract to Dear & Hayes, of Duluth, for building a double track elevated railway from West Superior to the heart of the city of Duluth for the joint use of its trains and the trains of the Duluth, South Shore & Atlantic. The structure will contain about 2,600,000 ft. B. M. of timber and about 16,000 piles will be driven for the foundation. These tracks will be used for passenger trains, and beneath them will be two surface tracks for freight traffic. The company has begun condemnation proceedings for 46 city lots near the business center of Duluth, valued at $250,000. Here a union depot and terminal tracks are to be erected. The elevated structure for the passenger tracks is to be completed by Dec. 20.

Duluth & Winnipeg.—The president of the construction company which has the contract for the first 50 miles of this road, is A. W. WRIGHT, of Alma, Mich. (Not Alva, as our contemporaries have it). A subcontract for the first 10 miles has been let to Foley Bros. and work is to be pushed at once.

New Projects and Surveys.

Sioux City & Northern.

SIOUX CITY, Ia., Oct. 13, 1888.

EDITOR ENGINEERING NEWS:

The Sioux City & Northern Railroad has been surveyed the past summer from Sioux City to Flandreau, Dak., 120 miles. The line parallels the Illinois Central railroad for 28 miles and runs then *via* Merrill, Maurice, Sioux Center, Doon, Valley Springs and Palisades. The line has a max. gradient of 0.6 per cent. and a max. curvature of 3°. It runs through a fine agricultural country, producing corn, flax, wheat, cattle and hogs. Right of way has been secured for 100 miles and Sioux City has voted a 3 per cent. tax in aid of the enterprise, which will amount to about $300,000. JOHN HORNICK is President of the company. Capt. T. P. GERE, of Sioux City can give further information in regard to the enterprise. L. F. WAKEFIELD is Chief Engineer. WAKEFIELD & HILL.

Northern Michigan. — This company has been chartered in Michigan to build a railroad from Houghton to Watersmeet, about 70 miles. The incorporators are R. R. GOODELL, JAS. R. COOPER, JOHN R. DUNCAN, JOHNSTON VIVIAN and THOS. L. CHADBOURNE. C. A. WRIGHT is Vice President and General Manager with headquarters at Hancock, Mich. Surveys have already begun.

THE SOUTHWEST.

Existing Roads.

East Line & Red River.—The stock holders of this company at a recent meeting elected as directors JOHN C. BROWN, J. A. BAKER, W. H. ABRAMS, R. C. FOSTER, F. H. PENDERGRAST, ALBERT GOULD, JOHN BACON and E. W. TAYLOR. The line extends from Jefferson to Greenville, Tex., 124 miles, and forms part of the Missouri, Kansas & Texas system.

St. Louis & San Francisco.—The Little Rock, Ark., Board of Trade have formally expressed their wish to have this system extended to Little Rock, and have offered their coöperation and aid in securing right of way and subsidies.

St. Louis, Iron Mountain & Southern.—Work is to begin at once on the branch from the St. Louis, Iron Mountain & Southern railroad at Benton, Ark., to Hot Springs for which surveys have just been completed.

Hot Springs Branch.—The prospect of new competing lines to Hot Springs, Ark., will cause the managers of this road to widen the gauge to standard and put on new equipment. The line is 25 miles in length. J. REYNOLDS of Chicago is President of the company and J. N. CONGER, Hot Springs, Ark., is Superintendent.

Ft. Smith, Paris & Dardanelle. — This Arkansas company has laid 5 miles of track, which it was obliged to do in order to prevent its charter from lapsing.

Missouri Pacific. — Wall Street was greatly excited on Wednesday over a dispatch from Topeka, Kan., stating that the gross earnings for the past fiscal year were $12,600,000 while the expenses for the same time were $14,400,000. Missouri Pacific officials denounce the report as untrue; but the general feeling that the prospect for future dividends is less hopeful, is evidenced by the fact that the stock which sold as high as 112 last year, is now below 80.

Atchison, Topeka & Santa Fé. — The rumor that this company is pressed for money to meet its current expenses has been affirmed and denied very strenuously. It is officially announced, however, that $6,000,000 of second mortgage six per cent. bonds have been created and taken by friends of the company to tide it over its present need. Orders have been issued to reduce expenses in the mechanical department, the working hours being reduced 16 per cent. This will effect a saving of about $30,000 per week.

New Projects and Surveys.

Arkansas & Gulf.—This company has been chartered in Arkansas to build a railway from the State line between Arkansas & Louisiana at the terminus of the proposed Mississippi Valley railroad, to a point on the Kansas City, Fort Scott & Memphis Railway in Fulton county, about 275 miles. The incorporators are JOHN D. ADAMS of Little Rock, J. M. WHITEHALL and JAS. MURPHY of Arkansas City, J. BAXTER of Nashville, Tenn., and THOS. R. SHARP of New York City. The principal office is to be at Arkansas City.

Cherokee Central.—This company has been chartered in Kansas to build a railway from Fort Scott to Fort Smith, Ark., through the Indian Territory, about 200 miles.

Dodge City & Denver.—This company has been chartered in Kansas to build a railway from Dodge City direct to Denver, Col., A. T. SOULE of Rochester, N. Y., and W. W. MUNSON of Dodge City are among the incorporators.

ROCKY MOUNTAIN & PACIFIC.

Existing Roads

Chicago, Rock Island & Pacific. — The completion of the extension to Colorado Springs, Col., on which the last rail was laid Oct. 12, was celebrated by the citizens of Colorado Springs by firing guns and ringing bells, and a banquet to be held Oct. 26. This is considerably the longest extension of the present year, reaching from Norton, Kan., to Colorado Springs, Col., about 300 miles.

Fremont, Elkhorn & Missouri Valley. — The extension from Glen Rock to Casper, Wy., 25 miles, has just been opened for business. Casper is near the site of old Ft. Casper on the North Platte. It is 637.8 miles from Missouri valley and 1,104.9 miles from Chicago.

San Francisco & North Pacific. — It is stated that Seligman & Co., the New York bankers, are to float bonds for this company to the amount of $1,500,000 the proceeds of which will be used in extending the road to Eureka, Cal. A report has been started that this company and the Northern California are to be consolidated, and will be used as the California division of the first line which shall build into San Francisco from the northeast.

San Francisco & San Joaquin Valley. — According to the best information obtainable, President I. R. WILBUR'S trip east to raise money for the completion of this road was successful. There is little prospect that the line will be completed until investors become more anxious to invest money in parallel railroads than at present.

California & Nevada.—This narrow gauge road extends from Oakland, Cal., east to Oak Grove, about 15 miles, and is not now in operation. It is reported that the owners of the road propose to extend it about 20 miles to Bodie and will begin operations at once. CALVIN PRATT is Chief Engineer. The general office is at Oakland, Cal.

Pueblo Union Depot.—Work is to begin next month on the union depot at Pueblo, Col., to be used by the Santa Fé, Denver & Rio Grande, Denver & Fort Worth, Rock Island and Missouri Pacific. Its cost is estimated at $150 000.

Mason County Central.—Grading is in progress on the first section of this road near Shelton, W. T. W. H. KNEELAND of Shelton is President.

Northern Pacific.—Track has just been laid on a 7 mile branch from Philipsburg to Ramsey, Montana. Contractor G. W. HUNT will finish the extension from Cheney to Davenport, W. T., before winter.

Oregon & Washington Territory.—The Eureka Flat branch is completed to Lemar, 30 miles from Wallula, W. T., and is graded all the way to Walla Walla. Track will be laid into Walla Walla before the end of October.

Mexican National.—A contract is reported let for a branch to Cedral, in the State of San Luis Potosi, about 25 miles from the main line. The line is projected to tap a rich mining district.

Union Pacific.—A dispatch from Greenville, Cal., to the California Associated Press, states that a corps of surveyors, numbering about 35, are at work in Plumas county, Cal., locating a railway line from Big Meadows down the north fork of the Feather river. The party are thought to be in the employ of the Union Pacific.— Union Pacific surveyors are also reported at work on a line from Gunnison, Cal., westward, with a branch to Montrose and Telluride.

San Francisco, Humboldt & Cedar Lake.—This company has sold its franchise, rights of way, partly graded roadbed, etc., to the Southern Pacific company, which probably will make use of the franchise at some future time for building a railway into Lake county, Cal.

Southern Pacific.—The report which has been in circulation that President LELAND STANFORD intends to resign his office at the next annual meeting is contradicted, together with another interesting statement that the reason the stock of the company does not pay as large in dividend as some Eastern roads is because the high officials of the company receive such large salaries.

International Company of Mexico.—It is stated that the railroad from San Diego, Cal., to Ensenada, in Lower California, will be built this winter. President EDGAR T. WELLES is now at Ensenada. B. SCOTT is Superintendent of Construction, with headquarters at San Diego.

New Projects and Surveys.

San Diego & Cuyamaca.—It is stated that this company has made arrangements for the sale of $500,000 worth of bonds and has purchased ties enough for 225 miles of road. The line is to run from San Diego, Cal., to San Bernardino. R. W. WATERMAN of San Diego is President.

Livermore Valley.—This California company proposes to build a railway from Altamont Station, on the Central Pacific, to Livermore coal mines, about 10 miles. HENRY JACKSON is the Chief Engineer.

Proposals Open.

Sewerage.—The complete plans accepted afford drainage for a city of 32,000 inhabitants and will cost about $100,000; only the sewers in the main portion of the city will be laid at present. THE CITY RECORDER, Austin, Tex.

Street Work. — Excavation, filling, paving, curbing, flagging, vitrified pipe, basins, etc. MARTIN FINCK, Clerk, Board of Public Works, Jersey City, N. J. October 22.

Sewage Pumping Plant. — Two pumping engines, with boilers, etc. A. V. POWELL, Superintendent of Public Works, Hyde Park, Ill. October 23.

Pier Work. — At foot of W. 33rd St., North river. THE DOCKS COMMISSIONERS, Pier A, North river, New York City. October 24.

Street Work.—Regulating, trap block paving, grading, curbing, etc. THE PARKS COMMISSIONERS, 49-51 Chambers St., New York City. October 24.

Sewers. — Vitrified salt-glazed pipe, 12, 15 and 18-in.; basins and manholes. ERNEST ADAM, City Surveyor, Newark, N. J. October 25.

Sewers.—Branch and main sewers. LOUIS WAGNER, Director of Public Works, Philadelphia, Pa. October 25.

Bridges.—Two iron bridges across the Teton river in

Choteau Co., Mont.; (1) at Fort Benton, 150 ft. span, 16 ft. roadway, concrete piers cased in ⅜-in. iron and set on foundation of 7 piles; at Choteau, 110 ft. span, 5 piles to each pier. A. E. ROGERS, County Clerk, Fort Benton, Mont. October 26.

Street Work.—Regulating, grading, curbing and flagging. THE COMMISSIONER OF PUBLIC WORKS, 31 Chambers St., New York City. October 29.

Sewers.—About 11 miles of pipe sewers and necessary manholes. Plans at the office of T. WM. HARRIS & Co., 44 Broadway, New York City, and at the office of LEE & ASTON, Resident Engineers, Asheville. H. S. HARKINS, Mayor, Asheville, N. C. October 29.

Street Work.—Grading, graveling, draining, etc. JAY F. BROWN, Engineer, Seneca St., Cleveland. CHAS. B. COOK, Village Clerk, Glenville, O. October 31.

Sewers.—About 9 miles of pipe sewers, with manholes and flush tanks, at Pine Bluff. Plans at the office of the City Engineer, or of J. H. HANEY, Little Rock. J. F. SIMMONS, Chairman of Improvement Commissioners, Pine Bluff, Ark. November 1.

Water-Works.—Water tank, pumps, pumping station, 600 or 800 ft. of 8-in. pipe. C. S. YOUREE, Clerk, Board of Trustees, Venice, Ill. November 2.

Bridges.—Two bridges. W. H. CURTIS, Meridian, Miss. November 5.

Court House.—Foundations, November 10; superstructure, November 20. A. B. CROSS, Architect, 16 W. Missouri Ave., Kansas City, Mo.

Sewers.—Furnishing material (except pipe) and laying pipe. J. H. SKINNER, City Engineer. J. A. MCCONNELL, Chairman, Sewer Committee, Roanoke, Va. November 10.

Viaduct.—Over the B. & M. and U. P. railway tracks; 1,135 ft. of pile trestle, 96 ft. through truss, two 134 ft. through trusses (steel or combination trusses); total length, 1,495 ft.; 32 ft. wide (22 ft. roadway and two 5 ft. sidewalks); live load, 100 lbs. per sq. ft.; dead load, on trestle, 50 lbs. per sq. ft. Plans at the office of the City Engineer. I. F. BAYLESS, Chairman, Committee on Streets and Alleys, South Omaha, Neb. November 15.

GOVERNMENT WORK.

Lock.—Lock No. 7, Kanawha river improvement. ADDISON M. SCOTT, Resident Engineer. Col. WM. P. CRAIGHILL, U. S. Engineer Office, Charleston, W. Va. October 23.

Wire.—Wire strands, 27,600 ft. of ⅝-in., 24,400 ft. of ½-in., 27,600 ft. of ⅜-in. Capt. SMITH S. LEACH, U. S. Engineer Office, Memphis, Tenn. October 25.

Revetment.—At St. Clair Flats ship canal, Michigan. Col. O. M. POE, U. S. Engineer Office, Detroit, Mich. October 26.

Dredging.—Dredging and removing about 16,000 cu. yds. of boulder, sand, mud, etc., from channel between North and South Hero Ids., Vermont. October 29.——Dredging and removing about 28,000 cu. yds. of sand, mud, etc., behind breakwater at Plattsburg harbor, New York. October 31.——Dredging about 75,000 cu. yds. from the Narrows of Lake Champlain, New York. November 12.——Major M. B. ADAMS, U. S. Engineer Office, Burlington, Vt.

Breakwater.—Extending breakwater at harbor of refuge, Milwaukee bay; 400 ft. Major CHAS. E. L. B. DAVIS, U. S. Engineer Office, Milwaukee, Wis. October 31.

Dredging, Stone, Etc.—About 150,000 tons of rubble stone for harbor of refuge, Sandy bay, Cape Ann, Mass. October 31.—Dredging about 20,000 cu. yds. and removing about 100 cu. yds. of ledge, at Gloucester, Mass. October 31——Dredging about 6,000 cu. yds. from Ipswich river, Mass. November 1.——Dredging about 30,000 cu. yds. at Scituate, Mass. November 2. —— Removing about 200 cu. yds. of ledge at Hingham, Mass. November 2.——Quarry faced granite ashlar for the extension of the Gallop's Id. sea wall, Boston harbor. November 3.——Dredging about 40,000 cu. yds. at Lynn, Mass. November 3.——Dredging about 25,000 cu. yds. at Wellfleet, Mass. November 3——Lt. Col. G. L. GILLESPIE, U. S. Engineer Office, Boston, Mass.

Jetties.—At the mouth of the St. John's river. Capt. W. M. BLACK, U. S. Engineer Office, Post Office Building, Philadelphia, Pa. November 5.

Dredging and Rock Excavation.—In the Niagara river. Capt. F. A. MAHAN, U. S. Engineer Office, Buffalo, N. Y. November 24.

Breakwater.—Sand, pebble, stone and cement for reconstructing the breakwater at Buffalo. Capt. F. A. MAHAN, U. S. Engineer Office, Buffalo, N. Y. December 1.

Contracting.

Locomotives.—The Portland Co., of Portland, Me., has contracts in hand for locomotives for the Grand Trunk, Ry., Boston & Maine R. R. and Portland & Rochester R. R. The company has also conracts for freight cars for the Maine Central R. R., and for pulp-mill and other machinery.

The Casco Carbonized & Cement Pipe Co., of Portland, Me., which was started about 4 years ago, has plenty of work on hand for cement drain pipe and carbonized stone pipe. The company also manufactures flagging, tile, etc.

The National Electric Railway Co. has been incorporated at Newark, N. J., by CHARLES E. POWERS, W. G. BENEDICT, and A. D. MCCLELLAN, of Boston; C. W. and C. T. PARKER, of Newark; W. PATTERSON, of Perth Amboy, N. J., and W. A. BOLAND, of Lynn, Mass. The company will undertake the construction and equipment of electric street railways, and has a capital stock of $100,000.

Bridge.—Rockbridge Co., Va., will build a highway bridge of 50 ft. span. For particulars address D. C. HUMPHREYS, Lexington, Va.

Trenching.—The contracts for trenching for the gas pipe line from the wells to Perrysburg, O., a distance of 29,000 ft., have been let in 13 sections, 12 being 2,500 ft. each and one 1,500 ft. The contract prices ranged from 25 cts. to 41½ cts. per rod, but most of the work was let at 30 cts.

Drawing Instruments.—THEODORE ALTENEDER, manufacturer of drawing instruments, Philadelphia, Pa., has issued a new and enlarged illustrated catalogue and price list of patented and improved instruments. Attention is called to the patent joint for compasses, etc. Copies of the catalogue will be sent free on application.

The St. Louis Vise & Artesian Well Tool Co., of St. Louis, Mo., has issued a new catalogue of horse and steam power drilling plants of various types. The catalogue also gives lists and prices of tools, well casing, earth boring plant, etc. There is also a description of the Lane expansion reamer for reaming the well ahead of casing.

Government Work.—***Detroit River, Michigan.***—The following proposals for improving the Detroit river were opened October 15, by Col. O. M. POE, U. S. Engineer Office, Detroit, Mich.: Dunbar & Sullivan, Buffalo, N. Y., excavating 14,465 cu. yds. of solid rock, $4.43 per cu. yd. in place; excavating 100 cu. yds. of rock, $1 per cu. yd. in place; Carkin, Stickney & Cram, East Saginaw, Mich., $4.48, $1; Hickler & Greene, Saulte Ste. Marie, Mich., $4.75, 60 cts.; Jennings & French, Fulton, N. Y., $5.20, $5.20; L. P. and J. H. Smith, Cleveland, O., $5.50, $2; William Patrick, Fulton, N. Y., $5.80, $2.

Machine Tools.—Messrs. Pedrick & Ayer, of Philadelphia, Pa., have issued an illustrated catalogue of special tools for railway repair shops, etc. It is a pamphlet of 88 pages, with good illustrations and descriptions of various types of machine tools, and special machines. The latter include portable improved machines for boring locomotive cylinders, milling steam-chest seats, turning crank and wrist pins, planing driving boxes, drilling, key seating, etc. In most cases prices are given. There are 12 blank pages for memoranda.

City Work.—***San Francisco, Cal.***—The Street Committee has awarded the following contracts: A pipe sewer in Sansome St., to Charles R. Heverin, at $3.10 per lin. ft.; aggregate, $885; regrading, etc., to Champion & Elder, 37½ cts. per sq. ft.; aggregate $1,006.85; remacadamizing Eddy St., to Champion & Elder, at 37½ cts.; aggregate $619.38; regrading, to A. C. Diggins, at 35¼ cts.; aggregate $250; also Guerrero, to Champion & Elder, at 35½ cts.; aggregate $1,471.41; paving the south side of Pine St., to D. Harney, at 34 cts. a sq. ft.; aggregate $3,600; paving Union St. to H. C. Partridge at 30 cts.; aggregate $4,265; paving Geary St., to D. Harney, 32½ cts.; aggregate $3,600; paving with bituminous rock Washington Street, from Jones to Leavenworth, to Pacific Paving Company, at 27 cts. a sq. ft.; aggregate $3,473; brick sewer in the crossing of Eighteenth and Guerrero Sts., to C. B. Williams, at $4.68 per lin. ft.; aggregate, $759.62; a pipe sewer in Beale St., to L. Fitzgerald, at $2.03 per lin. ft.; aggregate $1,500.

Street Work.—***Brooklyn, N. Y.***—The following proposals have been received for grading and paving: John J. O'Brien, $3.69 per lin. ft.; Henry A. Nolan, $4.34; John Hart, $5.37.

East Orange, N. J.—The contract for macadamizing Beach and Chestnut Sts. has been awarded to Thomas Nevins & Son at the following prices: Macadam, $1 per sq. yd.; curbing 34 cts. per ft.; gutters, 16 cts. per ft., and 27 cts. for excavating.

Hyde Park, Ill.—The contract for the improvement of Forty-Second Street, between Grand Boulevard and Vincennes Avenue, has been awarded to Dolese & Shephard at their bid of $4,300.

Cincinnati, O.—The Board of Public Affairs has awarded to O. E. Rollins the contract for the improvement of Armour alley at his bid of $3,543.50 and to M. F. Flynn the contract for Turrill Street at his bid of $2,337.40.

St. Paul, Minn.—The Board of Public Works has awarded the following contracts: Grading Tremont Street, to Wade & Jones, $3,131.74; grading alleys in blocks 13, 14 and 15, or Lewis' Second addition, to J. T. Million, $548; grading alley in block 3, of Lewis' addition, to Carl Bahr, $300.

Kansas City, Mo.—The Improvement Committee has awarded contracts for paving at $1.32 to $1.57 per sq. yd.; for grading at 12½ cts. to 35 cts. per cu. yd.; for curbing at 63 cts. per lin. ft.

The Worthington Pumping Engine.—The illustrated circular for 1888, published by H. R. Worthington, of New York City, is an interesting as well as useful book to have on hand, as it contains engravings and sectional views of high duty pumping engines of different classes, with descriptions and general information. There are also a record of the Worthington engines, a list of places where they are used, and a description of indicator cards taken from the engines. Mention is of course made of the Worthington specialty, the "high duty attachment", by means of which the economy of high expansion is secured without the aid of a crank and fly wheel.

Railway Contracts.—***Raritan River.***—A. B. Nelson, of New Brunswick, N. J., has the contract for grading this road from South River to New Brunswick.

Clinch Valley.—Ferguson & Vaughan, of Tazewell C. H., Va., have a six miles grading contract.

Chowan & Southern.—Harper, Bruce & Co., of Suffolk, Va., have the contract for the earthwork from Drivers, Va., to Tunis, N. C., 36 miles; and from near Roberdel, N. C., to Tarboro, N. C., 37 miles.

Owensboro, Falls of Rough & Green River.—J. M. W. Field, Owensboro, Ky., has the contract to build the road and is to commence work by January.

Roanoke & Southern.—Griffin & Gordon, of New York, have the contract for grading and bridges from Winston, N. C., to Walnut Cove, 18 miles. Work is to be started at once.

Louisville, New Orleans & Texas Pacific.—J. S. McTighe & Co., of Memphis, Tenn., have the contract for the construction of the branch from Belmont, Miss., to Beulah, 20 miles.

Fort Smith & Gurdon.—McCarthy & Kerrigan, of Little Rock, Ark., who have the contract for constructing the line from Fort Smith to Greenwood, have sublet contracts as follows: first 10 miles to John Lee; 5 miles to Baker & Lee, of Fort Scott, Kan., 2 miles to C. E. Brown, of Dallas, Tex.; 1 mile to W. J. Brown, of Little Rock, and the last 3 miles to Arnold Bros., of Fort Smith, Ark.

Northern Pacific.—Thomas Fortune, of Bismarck, Dak., has the contract for filling the trestle at that city.

Oregon Pacific.—Job & Neugass, of Corvallis, Ore., have the contract for completing 10 miles east of Albany, Ore.

Sewers.—***Asheville, N. C.***—The following proposals for furnishing about 60,000 ft. of sewer pipe and specials were opened Oct. 8: W. W. Harris, (agent), Louisville, Ky., $16,827.25; Hegeman & Hildebrand, Asheville, $17,169.15; Penniman & Co.; Asheville, $17,774.50; H. J. Conkling, Cincinnati, O., $17,972.92; Blackmer & Post, St. Louis, $19,622.95; Wm. Wirt Clark & Sons, Baltimore, Md., $20,738.45; Dickinson & Co., Asheville, $21,453.07; George F. Sperry, (agent), Akron, O., $22 283.56. The contract was awarded to W. W. Harris. Messrs. LEE & ASTON are the Resident Engineers.

Wichita, Kan.—The following proposals for the construction of sewers were opened Oct. 10: Sullivan & Steinmetz, Wichita, $290,844.85; N. Williams, Denver, Col., $290,215.90; R. Clements, Cleveland, O., $290,988,25; J. Howard, Wichita, $295,759.72; Bailie & Churchwood, $296,721.22; M. Clarkson, Chicago, Ill., $302,254.95; D. P. Alexander, Wichita, $307,788.86; Dicker, Mollins & Taylor, Toledo, O., $316,105.22; James Prior, Denver, Col., $316,754.88; Ackerman & Bryan, Toledo, O., $318,494.85; John Everson, St. Louis, Mo., $318,921.81; W. R. Mercer, Terre Haute, Ind., $336,447.72; Lyons & Sweetson, Kansas City, Mo., $375,151.16; T. A. Bailey, Wichita, $427,099.73. The contract was awarded to Steinmetz & Sullivan, at $264,521.75, some of the items being cut down. O. MULVEN is City Engineer

Sewers.—***Central Falls, R. I.***—The contract for extending the Central St. sewer from High St. to the westerly side of Broad St. and for building a branch sewer on Railroad St. as far as Pacific St., has been awarded to Collins & Hamm, of Boston.

Chicopee, Mass.—The following were the bids for the construction of the main sewer at Chicopee Falls: Austin & Caldwell, of New Britain, $4.31 per ft.; Robert Hickey, $4.67; Wm. R. Kentland, of Chicopee Falls, $4.85; Collins & Kennedy, of Chicopee, $5; Sackett Bros., $5.60; Daniel O'Connell, of Holyoke, $6.17; Atkins & Co., $6.92. The contract was awarded to Austin & Caldwell.——Besides the sewer at the Falls 1,500 ft. of pipe sewer must be laid at an expense of about $2,200. The board will call for more bids for this, which will be confined to contractors living in town.

Jersey City, N. J.—The Board of Public Works has awarded sewer contracts to P. T. Plunkett and B. J. Waters.

Cleveland, O.—The Board of Public Improvements has awarded the contract for the Madison Ave. sewer to Clement Bros., at $119,000. The sewer will be 9 ft. diameter and over 2 miles long.

Cairo, Ill.—A contract for 12-in. pipe sewer has been awarded to Samuel Halliday at 57½ cts. per lin. ft.

Armourdale, Kan.—The contract for the big sewer has been awarded to A. J. Williams at $53,322.70.

Kansas City, Mo.—Sewer contracts have been let to Thomas Fisher at 85 and 75 cts. per ft. for 15 and 12-in. pipe.

Dredging.—***Calumet River, Illinois.***—The following proposals for improving the Calumet river were opened Oct. 10, by Capt. W. L. MARSHALL, U. S. Engineer Office,

Chicago, Ill.: Dredging 80,000 cu. yds. between the Forks and half a mile east of Hammond, Ind.; Burdick & McMahon, Chicago, 22 cts. per cu. yd., $17,600; Chicago Dredging & Dock Co., 24 cts., $19,200; Green's Dredging Co., Chicago 24½ cts., $19,600; Fitz Simons & Connell Co., Chicago, 25 cts., $20,300; Dodge & Petrie, Chicago, 27 cts., $21,600; Samuel O. Dixon, Racine, Wis., $28 cts., $22,400.——Dredging 770,000 cu. yds. between the mouth and 108th St.; W. A. McGillis & Co., Havana, Ill., 11¾ cts. per cu. yd., $90,475; Alabama Dredging & Jetty Co., Mobile, Ala., $14,⅞ cts., $114,730; Green's Dredging Co., Chicago, 18 cts., $138,600 Samuel O. Dixon, Racine, Wis., 19¼ cts., $148,225; Chicago Dredging & Dock Co., 19½ cts., $150,150; Fitz Simons & Connell Co., Chicago, 20 cts., $154,000; Williams, Unham & Co., Duluth, Minn., 22 cts., $169,400.

Rouge River, Michigan.—The following proposals for improving the Rouge river were opened Oct. 11 by Lt. Col. O. M. POE, U. S. Engineer Office, Detroit, Mich.: James Rooney, Toledo, O., 11½ cts. per cu. yd., scow measurement; Hubbell & Sheldon, Detroit, 14 cts.; Carkin Stickney & Cram, East Saginaw, Mich., 16 cts.; Quartus Gillmore, Lorain, O., 18¾ cts.; Charles F. Dunbar, Buffalo, N. Y., 23 cts.

Potomac River.—The following proposals for improving the Potomac river were opened Oct. 10 by Lt. Col. PETER C. HAINS, U. S. Engineer Office, Washington, D. C.: Dredging 1,200,000 cu. yds.; California Hydraulic Dredging & Reclamation Co., San Francisco, Cal., 12¾ cts. per cu. yd.; Alabama Dredging & Jetty Co., Mobile, Ala., 13 cts.; P. Sanford Ross, Jersey City, N. J., 18 cts.——Dredging and embankment; Class A, 250,000 cu. yds.; Henry Wilson Washington, 11½ cts. per cu. yd. Thos. P. Morgan, Washington, 16 cts.; Frank C. Somers, Camden, N. J., 16 cts.; National Dredging Co., Wilmington, Del., 17 cts. Class B, 60,000 cu. yds.; Thos. P. Morgan, Washington 22 cts. per cu. yd.; Frank C. Somers, Camden, N. J., 26 cts. or 29 cts. if required to dredge in exceeding 17 ft. depth of water.

Government Work.—***Aransas Pass, Texas.***—The following proposals for protecting the shore of Aransas pass from erosion, were opened Oct. 10 by Major O. H. ERNST, U. S. Engineer Office, Galveston, Tex.: Charles Clarke & Co., of Galveston, 18,000 cu. yds. of rip-rap at $2.99 per cu. yd., $53,820; A. M. Shannon & Co., of Galveston, $3.10, $55,800. The contract was awarded to Charles Clarke & Co.

Buffalo Bayou, Texas.—The following proposal for improving Buffalo bayou was opened Oct. 10 by Major O. H. ERNST, U. S. Engineer Office, Galveston, Tex.: J. J. Atkinson, Houston, Tex.; dredging 75,000 cu. yds. of material under water, 28 cts. per cu. yd.; dredging and scraping 1,500 cu. yds. of material above water, 24 cts. per cu. yd.; removing 3,000 cu. ft. of sunken logs, 6 cts. per cu. ft.; removing 250 cu. ft. of overhanging trees, 75 cts. per cu. ft.; removing stumps as may be necessary, 10 per cent. above actual cost; total, $24,192.50.

Calumet Harbor, Illinois.—The following proposals for the extension of the south pier were opened Oct. 10: H. B. Herr & Co., Chicago; 66,311 ft. B. M. of hemlock timber, $23 per 1,000 ft. B. M.; 22,930 ft. B. M. of pine timber, $36; 32 pine piles, $12 each; 7,633.58 lbs. of drift bolts, 4 cts. per lb.; 400.06 lbs. of iron screw bolts, 5 cts.; iron spikes, $5; 182,993 cords of stone, 9 cts. per cord: total for 150 ft. of work (2 cribs), $8,945.70. Fitz Simons & Connell Co., Chicago, hemlock, $29; pine, $33; piles, $12; drift bolts, 7 cts.; screw bolts, 8 cts.; spikes, cts.; stone, 9 cts.; total, $10,553.34.

Chicago Harbor, Illinois.—The following proposals for the extension of the exterior breakwater were opened Oct. 10: Fitz Simons & Connell Co., Chicago; 102,312 ft. B. M. of hemlock timber, $13 per 1,000 ft. B. M.; 17,391 ft. B. M. of pine timber, $17.50; 4,900 ft. B. M. pine plank, $15; 10,113 lbs. of iron drift bolts, 5 cts. per lb.; 228.47 lbs. of N and W iron screw bolts, 7 cts. per lb.; 841.18 lbs. of spikes, 5 cts.; 576,647 cords of stone, $6 per cord; 119,703 ft. B. M. of framing, $10 per 1,000 ft. B. M.; 4,900 ft. B. M. laying plank, $4 per 1,000 ft. B. M.; taking up plank, $4 per 1,000 ft. B. M.; total amount for 1,156 ft. (17 cribs), $118,117.87. H. B. Herr & Co., Chicago; hemlock, $13; pine timber and plank, $16 and $14; drift bolts, screw bolts and spikes, 4 cts.; stone, $6.80; framing, $8.75; laying plank, $6; total, $121,077.91. Chicago Dredging & Dock Co.; hemlock, $15; pine timber and plank, $21 and $18; drift bolts, 6 cts.; screw bolts, 7 cts.; spikes, 6 cts.; stone, $7; framing, $16; laying and taking up plank, $6; total, $146,922.61.

WATER.

Sewerage.—***Waterville, Me.***—Work has been commenced on the sewerage system and it is expected to have it completed early next year. Portland vitrified pipe is used.

Central Falls, R. I.—Work on the sewers is progressing rapidly.

Newport, R. I.—The town is said to be having a wrangle over the new sewer which was to be built for $80,000 but has already caused $150,000 to be drawn from the city treasury. A committee has been appointed to investigate this matter.

Providence, R. I.—A Council resolution has been passed ordering the construction of a sewer from Olneyville square at a cost of $22,722.63.

Springfield, Mass.—The appropriation of $25,000 for this year has been expended, 3 brick sewers in Hancock Street, the Boston road and St. James Avenue, with a number of pipe sewers, having been laid.

Owensboro, Ky.—A system of sewers is to be established. Address the mayor.

Asheville, N. C.—The new sewerage system will cost $100,000. E. D. BOLTON, (of T. W. Harris & Co.), of New York, is Consulting Engineer, and JOHN C. ASTON, City Engineer, will be in charge of the work.

St. Augustine, Fla.—A system of sewerage is being contemplated.

Cairo, Ill.—The Council has ordered the construction as soon as practicable, of all sewers that have been provided for by ordinance.

Minneapolis, Minn.—The Sewer Committee recently inspected the North Minneapolis sewer tunnel, work upon which has been at a standstill for several months owing to the constant flow of water and sand. Engineer VAN DUZEN is now conducting a series of experiments to see if some measure can be adopted to facilitate the work upon the tunnel.

Denver, Col.—The City Engineer has reported that by a recent change of the channel of the Platte river, the sewer outlet is again left to one side of flowing water. It is urgently necessary to at once continue the public sewer down stream. To do this in brick masonry, as will ultimately be required, will cost about $4,000 exclusive of any cost for right of way to meet the present necessities. To do it permanently will take not less than $50,000. To again temporarily extend by a wooden box like last year's work will cost about $1,000. The new extension will have to be 1,920 ft. long to again connect with the river. The Council has appropriated $1,000 for the work.

Los Angeles, Cal.—The City Council has adopted an ordinance submitting to the voters a proposal to raise $600,000, by issuing bonds, for sewers within the city. It was also asked that the proposal to raise $300,000 bonds for an outlet sewer be submitted to the people, but not at the same time as the other proposition.

Fort Worth, Tex.—The city has voted on an appropriation of $40,000 for new sewers.

Owosso, Mich.—With regard to the proposed waterworks, bids for the construction of which were to have been opened October 16, Mr. C. S. Williams, the mayor writes us as follows: "Our water supply not proving a success as yet, we have had to defer receiving proposals for water-works indefinitely. Will notify contractors again when we are better prepared, through same source." The work, as advertised in our columns, was to consist of about 6 miles of 4 to 12-in. pipe, 13 tons of specials, 70 hydrants, 75 gates, 75 gate boxes, pumping machinery with a daily capacity of 1,500,000 galls. and a pump house and chimney. Plans and specifications had been prepared.

Irrigation.—***California.***—The Farmers' Ditch Co., of Independence, Inyo Co., has been incorporated. Capital stock, $10,000. A. WALTER, GEO. W. HUCKEL, B. J. HART, J. S. MCCROSKY, E. M. BROWN.

The Cañon Irrigation Co. has also been incorporated, to conduct a general water business in San Jose township. Directors: H. A. PALMER, F. L. PALMER, B. S. NICHOLS, H. J. NICHOLS and C. M. STONE. Capital stock, $200,000.

Colorado.—The Minnesota Canal Co., of Delta Co., has been incorporated by AARON CLURGS, WESLEY AULE, J. W. LANE, B. J. GOODENOW and J. FLUALLAN. Capital stock, $8,500.——The Bear Creek & Cheyenne Cañon Reservoir Co., of Colorado Springs, has been incorporated by WALTER W. HATCH, A. A. WARREN, H. E. WARREN and M. T. HATCH. Capital stock, $100,000.

Nebraska.—The Bartley Canal Co. has been incorporated by citizens of Bartley, Neb., to construct a canal for irrigation and power purposes from the Republican river to the town. Capital stock, $10,000.——The Minetare Canal & Irrigation Co. has been incorporated by T. HARSMAN, W. CLARK, J. H. FAIRFIELD, J. F. RINGLER, A. M. FAIRFIELD, GEO. W. FAIRFIELD, W. C. TABOR, E. N. HARSHMAN and A. W. MILLS. The capital stock is $20,000. The company proposes to build and operate a canal in Cheyenne Co., Neb., taking water from the North Platte river and applying it to purposes of irrigation, manufacture, domestic use, etc.

Duluth, Minn.—The Duluth Gas & Water Co. recently commenced work for new gas works, in consequence of the bad location of the present works. In consequence of the attack upon the company to prevent its making a connection between the water-works of Duluth and West Superior, this work has been stopped.

The Weisbach Incandescent Gaslight Co. has been incorporated at San Francisco, Cal., to build gas works and acquire the incandescent gaslight patents of CARL A. VON WEISBACH. The directors are F. V. MCDONALD, COLUMBUS WATERHOUSE, H. L. COYE and JOHN L. STEWART. Capital stock, $1,500,000.

Electric Lighting for Freight Yards.—The California Electric Light Co. has put in a complete plant for lighting the freight yards of the Southern Pacific R. R. at Oakland, Cal., by incandescent lights. The Brush system is used and the plant gives great satisfaction.

Shelter Island, N. Y.—The water supply is drawn from a deep well, and is of excellent quality and ample quantity. A system of sewerage has been established.

Danvers, Mass.—The Water Commissioners have issued their report for the year ending Jan. 31, 1888. Cement lined pipe is recommended to be replaced with iron pipe. The total amount of water pumped was 159,331,832 galls. with a coal consumption of 493,563 lbs. At the date of the report there were 36 miles, 1,983 ft. of pipe, 205 hydrants, 193 gates, 1,212 services, and 70,072 ft. of service pipe. The report contains analyses of the water supply, made by the State Board of Health.

North Attleboro, Mass.—During the year ending March 31, 1888, only one pipe extension, 808 ft., was made 52 new services were laid and 1 hydrant set. The supply of water from the well continued of good quantity and quality. The total pumpage was 43,706,250 galls. An additional pump is recommended; the cost is estimated by Mr. DAVIDSON at $5,000, including foundations, fittings, etc., without condenser, or $5,500 with condenser. There were at the time of the report 10.67 miles of mains, 95 hydrants, 449 services, 1.786 mile of service pipe, and 171 meters. W. P. WHITTEMORE, is Superintendent.

Savannah, Ga.—During the year 1887 the water supply was changed from river to artesian water, increasing the pumping capacity from 8,000,000 galls. to 12,500,000 galls. per day. The net cost of the work was about $[illegible],000. There are two 10-in. wells, twelve 6-in. and one 4-in. The waste of water is said to continue at a fearful rate and meters are suggested. These particulars are from the city reports for 1887.

Galveston, Tex.—The city has granted an extension of the contract for a water supply from artesian wells. The state of affairs, as related in the Galveston *News* is about as follows:

The contract to furnish 10 artesian wells, with an aggregate flow of 2,000,000 galls. of water per day, for $80,000, was entered into between the city and LOUIS SIEGEL, of New York, on March 13, 1888. Mr. Siegel was to receive $15,000 when he furnished the first 500,000 galls. of water; and other payments as the work progressed, he further agreeing to furnish 1,000,000 galls. within 6 months after the date of contract and the other 1,000,000 galls., or the full amount required under the contract, within 9 months from date of contract. This contract became subject to forfeiture on Sept. 13, which was 6 months from date of contract, without the first 1,000,000 galls. of water having been furnished. In the meantime, in consideration of furnishing the money with which to carry out this contract, Mr. SIEGEL gave Messrs. Hawley & Heidenheimer a power of attorney, practically turning over the contract to them. Hence it was with these gentlemen that the Board of Water Commissioners had mainly to deal in renewing the contract after Sept. 13, when the original contract became forfeited owing to the non-compliance with its provisions.

The terms of the renewal, as suggested by the Board and accepted by Messrs. Hawley & Heidenheimer, are in substance that the time in which 1,000,000 galls. is to be furnished, is extended to 9 months from date of contract, the entire amount, or 2,000,000 galls. to be furnished within 12 months, or by March 13, 1889. In consideration of this extension of time Messrs. Hawley & Heidenheimer agree to accept the following amended conditions of payment; $15,000 to be paid when 750,000 galls. are furnished; $15,000 when 1,250,000 galls. are furnished; $15,000 when 1,750,000 galls. are furnished, and the balance of $35,000 when the required amount, 2,000,000, galls. are furnished.

Mr. SIEGEL made a protest against any action being taken by the Board in regard to any contract, without his approval. In reply to a query if the powers of attorney did not make Hawley & Heidenheimer the contractors, City Attorney FINLAY replied that it did not make them the contractors, but invested them with all the powers under the contract that Siegel had. He then briefly stated the contract or agreement under which the work is at present being prosecuted, viz., that in consideration of furnishing the money to carry on the work, Messrs. Hawley & Heidenheimer are to receive 60 per cent. of the profits, the law firm of McLemore & Campbell 20 per cent., and Mr. Siegel 20 per cent.

Pumping Engine Catalogue.—The Goulds Manufacturing Co., of Seneca Falls, N. Y., has issued the 27th edition, 1888-1889, of its catalogue, and this book of 288 pages is a very well got up and quite æsthetic publication of its kind. It is well printed in purple ink, with a fancy buff border on each page. It is called an "illustrated and descriptive catalogue and price list of pumps, engines, rams and hydraulic machinery, adapted for manual, animal, wind, water, steam, oil, gas and electric power", and it is full of details, cuts, prices, etc., of all kinds of pumping plant and appliances. There are a number of illustrations representing the various uses to which pumps may be applied, and several pages of useful information, tables, etc. Several pages are also devoted to a description of the works, with illustrations of the different departments, and there are also many advertisements. An index makes reference easy, and judging from the character of the book it will be kept as an ornamental and useful work by those who obtain a copy.

Pawtucket, R. I.—The new pumping engine has been put in operation. The engine is of the Corliss, compound high duty type; cylinders, 20 and 40 ins. diameter, stroke 40 ins.; pump plungers 13¾ ins. diameter, 40 ins. stroke; fly wheel, 20 ft diameter; suction and delivery pipes, 15 ins. diameter, the latter discharging into a 36-in. pipe The engine is 300 H. P., has a daily capacity of 6,000,000 galls. and makes 50 revolutions per minute. There are three upright Corliss boilers; diameter, 7 ft.; each boiler has 239 tubes, 2 ins. diameter and 10 ft. long. EDWIN DARLING is Superintendent of Water-Works.

Albion, N. Y.—The new water-works have been completed and tested, and have been accepted by the village. According to contract, fire streams were to be thrown 100 ft. high by direct pressure, and 75 ft. high by pressure from the water tower. At the official test on Oct. 5, streams were thrown 120 ft. high by direct pressure and 95 to 100 ft. high by pressure from the tower; five streams were thrown simultaneously. The supply is taken from wells 30 to 100 ft. deep, and the water is pure, cold and soft. The masonry power house contains the pumping engines, which are of the compound duplex type, and two 40 H.P. boilers. The mains are of 6, 8 and 10-in. cast-iron, with two 4-in. pipes to each hydrant. There are 80 double-nozzle, non-freezing hydrants, connected with the mains by means of the Bassett circulating hydrant branch. Valves are placed at street intersections. The water tower is 75 ft. high, built of steel plates, and rests on a foundation of Medina sandstone. The village pays an annual rental of $3,000 for fire protection. The works were designed and built by Bassett Bros., of Buffalo, N. Y., and are owned by the Albion Water-Works Co.

Lancaster, Pa.—The Water Commissioners have presented their report on the proposed new reservoir. The plans prepared by City Engineer SLAYMAKER represent a reservoir with two basins, each 325 ft. square, embankment 18 ft. at highest point; the excavation at the highest point would be 16 ft., making a depth of 34 ft. to the top of banks, and, when filled with water to within 3 ft. of the top, will hold 12,000,000 galls., making 24,000,000 galls. capacity for both basins. The cost of these basins, complete, will be $74,000. The banks of the basins would be 4 ft. higher than the top of the stand-pipe in the present reservoir. The site selected is on the highest ground near the city, 26 ft. above the bottom of the present reservoir. The soil is of good clay. With banks only 12 ft. high at the highest point, which would bring them within 2 ft. of the top of the stand-pipe now in use, the cost would be $10,000 less. To connect with the new water works, with a 36-in. main along New St., (which is the direct route), will cost about $75,000, laid in the ground complete.

Dam.—The Union Water Power Co., of Lewiston, Me., has nearly completed its new dam at Errol, N. H., at the outlet of the Androscoggin Lakes. The structure is 250 ft. in length, 22 ft. high, and 60 ft. deep, and 1,500,000 ft. of lumber have been used in its construction. After the framework is in place, the whole is filled with rock and gravel. As soon as this work is completed, the old dam that has done service for many years will be removed. The water in the river has, until the recent rains, been very low, which has been fortunate for the rapid completion of the work. About 60 men have been employed on its construction.

Bangor, Me.—The Joint Special Committee of the City Government has reported in favor of the city's establishing an electric plant at the water-works dam, for lighting the streets of the city, estimating a saving to the city over the amount now paid of from $2,500 to $3,500 per annum, and estimating the cost of the plant, in addition to the power, ready to be used, at from $14,000 to $16,000 for 100 arc lights, and from $18,000 to $22,000 for 150 are lights. The report has been accepted and the order passed for a joint special committee to obtain specifications and advertise for bids.

Water-Works.—***New York.***—Sandy Hill. The new water-works tower is 130 ft. high and is now completed.——Green Island. The water-works are completed and have been tested. They were built by Moffett, Hodgkins & Clarke, of Watertown, N. Y.——Schenevus. About 50 men are engaged on the trenching for the new water-works.——Westfield. The village proposes to put in a system of water-works; R. G. WRIGHT, GEO. W. PATTERSON H. C. KINGSBURY, A. A. COMSTOCK, JOHN ARD, A. S. PIERCE and S. F. NIXON have been elected Water Commissioners.——Albany. All of the 300 gang wells are now nearly ready for the test of the supply.

Pennsylvania.—Lancaster. The new 5,000,000 galls. pumping engine has been at work night and day for a week to fill the reservoirs in order to prepare for the suspension and removal of the other pumps from the old works.

Maryland.—Baltimore. Work is progressing on the new Guilford reservoir; the puddling trenches are being cut and the embankments made, every 3-in. layer of earth on the banks is well rolled. Jones & Thorne are the contractors. Work was commenced 3 months ago, and will be completed in about 2 years. W. BENTHALL is Resident Engineer, with G. T. KENLY as principal assistant.

Virginia.—Abington. The town has voted in favor of the proposition to issue $20,000 in bonds for water-works and electric light.

West Virginia.—Huntington. A test of the water-works has been made and reported to the Council as satisfactory.

Georgia.—Marietta. A vote will be held Nov. 14 on a proposition to issue bonds for establishing water-works and electric light.

Michigan.—Muskegon. Trenching has been commenced for the new water-works.——Lapeer. The new works have already about 100 consumers.——Detroit. The Water Board has ordered pipe laid in several streets.

Illinois.—Springfield. Work is progressing favorably on the aqueduct and gallery.——Alton. The new contract with the water company will go into effect Jan. 1.

Minnesota.—St. Peter. Work on the new water-works is reported to have been suspended owing to some misunderstanding with the contractors.——Duluth. The water company has been requested by the city to build a new reservoir, the old one having been declared unsafe.

Iowa.—Mason City. Owing to the increasing number of consumers the capacity of the water-works must be increased. The Water-Works Committee has had estimates made for the deepening and enlarging of the present reservoir; also for constructing a new reservoir near the existing one. Another project is to bore a deep well for an artesian supply by natural power or by pumping.

Arkansas.—Morrillton. Kansas parties have made a proposition to build water-works. For particulars address the mayor.——Rogers. The pumps are being put in for the Rogers Water Co.

Nebraska.—Tekamah. Water-works are projected. Address the City Clerk for information.

Texas.—Fort Worth. The gang wells have been tested with satisfactory results. A new and larger pumping engine is to be put in at the water-works.——Eagle Pass. The Eagle Pass Water-Works & Irrigation Co. has been incorporated at Austin.

Canada.—Vancouver, B. C. The Vancouver Water Co. agrees to furnish the city with water for 50 fire hydrants at $50 per hydrant per annum. All other water required by the city to be at the rate of $600 per annum.

Special Reports of Water-Works Construction.

THE ENGINEERING NEWS MANUAL OF AMERICAN WATER-WORKS is now being compiled, and will be *indispensable* to every manufacturer, engineer and contractor in any way interested in Water-Works construction and maintenance, and will be of great value to Water-Works superintendents and projectors of new works.

Superintendents of water-works and water companies will wish to see correct and complete data concerning their Works in our MANUAL, and to ensure this they should send in reports *at once* upon the blanks which we have already sent to every Water-Works office in the United States and Canada. Many have delayed their report, and if the blanks we intended for them have been lost in the mail, or mislaid, we will send more upon request.

We *must* have a report from every public water supply system in North America, so those who reply to our inquiries at once will save a second inquiry. We also wish to know of *every* new Water-Works plant in process of construction, and of *every* new project in this line. We will send to any one desiring them, blanks upon which reports can be made.

Further details of the MANUAL will be advertised later. We abstract from our special reports for the MANUAL the following items of current interest:

MOORESTOWN, N. J., Oct. 13, 1888.

EDITOR ENGINEERING NEWS:—The Moorestown Water Co. began to operate its works here about Sept. 1, 1888. The works were begun in the fall of 1887, by Col. W. W. TAYLOR as Engineer and Contractor, and finished by the Pennsylvania Pipe Mfg. Co., of Germantown Junction. The water supply is small spring fed streams, collected in a reservoir, and is conveyed by gravity about 1,500 ft. to pump-well, from which a 1,000,000-gall. duplex Blake pump forces it to a tank whose top is 150 ft. above water surface of reservoir. The tank is of cedar, 23 by 25 ft., placed on a circular brick tower having stone and cement foundations. Its capacity is about 70,000 galls. There are about 7½ miles of patent iron and cement pipe, furnished by the last contractors, 42 taps, 50 hydrants, for which the town pays a yearly rental of $20 each. The ordinary pressure is 65 lbs., and fire pressure, 100 lbs. The works cost $40,000, paid up capital stock. The President of the company is Dr. N. NEWTON STOKES; Secretary and Treasurer, SAMUEL K. ROBBINS. Population, 2,000.

S. K. ROBBINS, *Treasurer.*

DUBOIS, Pa., Oct. 14, 1888.

EDITOR ENGINEERING NEWS:—Our population is 7,000 and we have no water-works, but we want some individual or company to put in a system. The borough will rent fire hydrants, and contracts can be made for 500 consumers the first year. W. C. PENZ, City Clerk.

GREENSBURG, Pa., Oct. 12, 1888.

EDITOR ENGINEERING NEWS:—Water-works are now being built here. GEO. D. HAFF.

ROCHESTER, Pa., Oct. 12, 1888.

EDITOR ENGINEERING NEWS:—The Rochester Water Co. will probably begin the construction of water-works May 1, 1889, with ELLIS MORRISON, of Rochester, as Engineer and Contractor for the entire plant. Water will be taken from the Ohio river, through a filter gallery, and pumped to a 5,000,000-gall. reservoir at an elevation of 350 ft. The pump will have a daily capacity of 3,000,000 galls., and there will be 7 miles of from 4 to 10-in. mains. A 30 years contract has been made with the town for 60 hydrants at a total rental of $2,750. The estimated cost of the works is $100,000, and it will be met with paid up stock, and with bonds at 6 per cent. It is estimated that the annual operating expenses of the works will be $2,500; and the annual revenue from consumers $6,000. The President of the company is JNO. M. BUCHANAN. Population, about 5,000. A. W. MCCOY.

LAS ANIMAS, Col., Oct. 12, 1888.

EDITOR ENGINEERING NEWS:—On Oct. 2, the village voted to issue $30,000 bonds for a system of water-works, the vote standing 103 for and 5 against the project. Water will be pumped from a well 24 ft. in diameter and 24 ft. deep to a tank with a capacity of 90,000 galls. resting on stone piers 30 ft. high. There will be about four miles of mains. Bids will be advertised for as soon as plans and specifications are ready, about the last of October. The Chairman of the Water-Works Committee is FRANK KREYBILL, and the Engineer is FRANK P. ARBUCKLE, of Lamar. Population about 1,200. HORACE E. COLLINS, *Clerk.*

RECORD OF NEW WATER WORKS CONSTRUCTION.

(Specially communicated).

CONTINUED FROM PAGE 298.

Old Orchard, Me.—The works were commenced July 1, 1887, and completed December 10, 1887. They were designed by B. R. CLARKE, of Boston, and M. M. TIDD, of Boston, was Constructing Engineer. The contractors were Turner, Clarke & Rawson, of Boston, Mass.; the pumping machinery was furnished by the Geo. F. Blake Mfg. Co., of Boston.; the pipe by the Donaldson Iron Co., of Emaus, Pa.; the specials by the Builders' Iron Foundry, of Providence, R. I., and the valves and hydrants by the Chapman Valve Mfg. Co., of Indian Orchard, Mass.; the trenching and pipe laying was done by C. W. Talcott, of Woonsocket, R. I. The source of supply is a spring 3 miles from the town, and the supply is by gravity, with direct pumping for fire purposes. At the spring is a reservoir, roofed over, having a capacity of 390,000 galls. There is a Herreshoff boiler and a simple duplex pump of 1,000,000 galls. daily capacity. There are 3 miles of conduit, 3¾ miles of distributing pipe, and 25 hydrants. Services are being laid. The mains are of cast-iron, and the services of galvanized iron. Ordinary pressure, 40 lbs; fire pressure, 100 lbs. On a fire alarm being given, steam may be raised and the pump started in 6 minutes. The franchise is for 20 years, and the hydrant rental is $40 per hydrant per annum. The works are owned by the Old Orchard Water Co.; President, A. B. TURNER; Treasurer, J. WENTWORTH BROWN; capital stock, $75,000. J. W. DUFF is Superintendent. The population is 1,000 in winter and 5,000 in summer. (Date of special report; May 15, 1888).

Billings, Mont.—The works were commenced in June, 1886, and water was turned on in 1887. The engineer was H. W. ROWLEY. The work was mostly let in small contracts by day labor. The Ludlow double-discharge hydrants are used. The source of supply is the Yellowstone river, and the water is pumped direct by one Dean and one Blake duplex power pump, plunger pattern; daily capacity of pumps, 2,000,000 galls. There are 5¼ miles of pipe, 15 hydrants, and 120 taps; the mains and services are of kalamein pipe. Average daily consumption, 150,000 galls. Ordinary pressure, 50 lbs; fire pressure, 100 lbs. Cost of works, $60,000; bonded debt, $39,000; rate of interest, 7 per cent. Annual revenue from consumers, $4,000; from city, $1,500. The franchise is for 20 years, and the hydrant rental is $100 per hydrant per annum. The works are owned by the Billings Water Power Co.; President, HENRY BELKNAP; Treasurer, H. H. MUND; Secretary and Superintendent, H. W. ROWLEY. Capital stock $50,000; bonds issued, $39,000, The present population is 1,800. The construction of the works included the construction of a canal leading from the Yellowstone river, 1 mile long, 18 ft. wide at the bottom, with 7 ft. depth of water, and giving a head of 12 ft. when it empties back into the river. This is designed to furnish power for various purposes The company owns and operates in connection with the water-works, an electric light plant; the dynamos are located at the pumping station and run by water power. The light is operated so conveniently in connection with the water-works that the expenses are increased but very little, making the investment pay from the start. The total income from all sources is about $9,000; the total expenses and interest on bonds is about $6,000. (Date of special report; May 18, 1888).

(TO BE CONTINUED).